

AD-A145 647 AIR FORCE HUMAN RESOURCES LABORATORY ANNUAL REPORT -  
FISCAL YEAR 1983(U) AIR FORCE HUMAN RESOURCES LAB  
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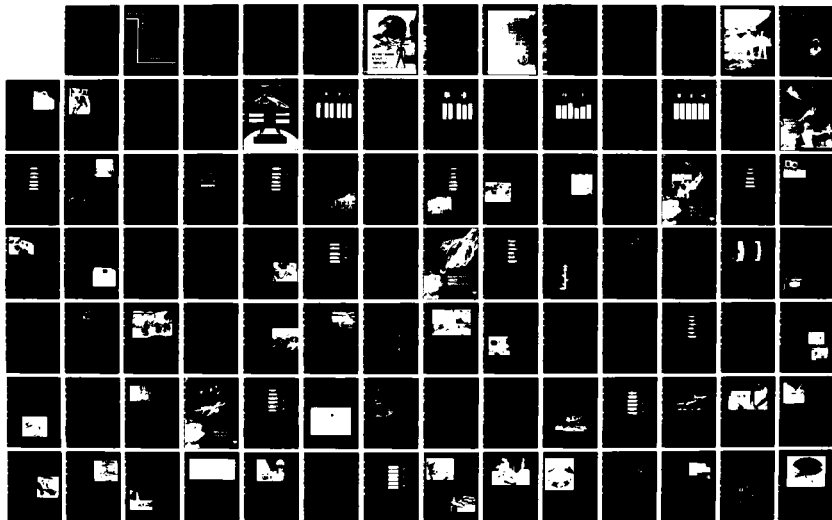
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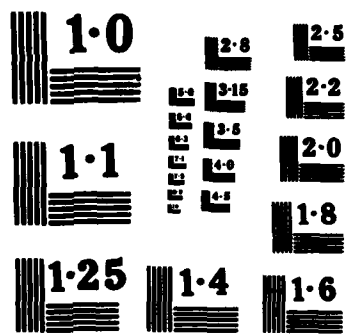
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ANNUAL REPORT - FISCAL YEAR 1983**

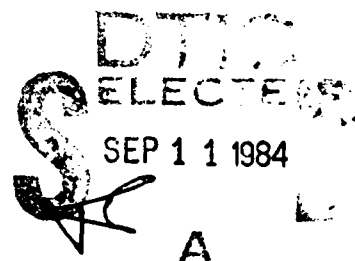
Edited by

**Ruth M. Buescher**

**TECHNICAL SERVICES DIVISION  
Brooks Air Force Base, Texas 78235**

August 1984

Final Technical Paper



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**LABORATORY**

**AIR FORCE SYSTEMS COMMAND  
BROOKS AIR FORCE BASE, TEXAS 78235**

**84 09 10 085**

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE

## REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION Unclassified			1b. RESTRICTIVE MARKINGS									
2a. SECURITY CLASSIFICATION AUTHORITY			3. DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release; distribution unlimited.									
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE												
4. PERFORMING ORGANIZATION REPORT NUMBER(S) AFHRL-TP-84-2			5. MONITORING ORGANIZATION REPORT NUMBER(S)									
6a. NAME OF PERFORMING ORGANIZATION Technical Services Division Air Force Human Resources Laboratory		6b. OFFICE SYMBOL (If applicable) AFHRL/TS	7a. NAME OF MONITORING ORGANIZATION									
6c. ADDRESS (City, State and ZIP Code) Brooks Air Force Base, Texas 78235			7b. ADDRESS (City, State and ZIP Code)									
8a. NAME OF FUNDING/SPONSORING ORGANIZATION Air Force Human Resources Laboratory		8b. OFFICE SYMBOL (If applicable) HQ AFHRL	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER									
6c. ADDRESS (City, State and ZIP Code) Brooks Air Force Base, Texas 78235			10. SOURCE OF FUNDING NOS.									
			<table border="1"> <tr> <td>PROGRAM ELEMENT NO.</td> <td>PROJECT NO.</td> <td>TASK NO.</td> <td>WORK UNIT NO.</td> </tr> <tr> <td>X</td> <td>9983</td> <td>04</td> <td>51</td> </tr> </table>		PROGRAM ELEMENT NO.	PROJECT NO.	TASK NO.	WORK UNIT NO.	X	9983	04	51
PROGRAM ELEMENT NO.	PROJECT NO.	TASK NO.	WORK UNIT NO.									
X	9983	04	51									
11. TITLE (Include Security Classification) Air Force Human Resources Laboratory Annual Report - Fiscal Year 1983												
12. PERSONAL AUTHOR(S) Buescher, Ruth M.												
13a. TYPE OF REPORT Final +		13b. TIME COVERED FROM 1 Oct 82 TO 30 Sep 83	14. DATE OF REPORT (Yr., Mo., Day) August 1984	15. PAGE COUNT 162								
16. SUPPLEMENTARY NOTATION												
17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number) air combat tactics and training Air Force Human Resources Laboratory mission, organization manpower and force management									
FIELD	GROUP	SUB. GR.										
19. ABSTRACT (Continue on reverse if necessary and identify by block number)  This paper presents the Air Force Human Resources Laboratory (AFHRL) mission, corporate philosophy, and descriptions of its research and development (R&D) thrusts. Fiscal year 1983 technical achievements and ongoing R&D are organized under each thrust area. It further outlines AFHRL organizational structure, the functions of its divisions and staff offices, and available technical resources. It lists publications and presentations by Laboratory personnel during fiscal year 1983.												
20. DISTRIBUTION/AVAILABILITY OF ABSTRACT  UNCLASSIFIED/UNLIMITED <input checked="" type="checkbox"/> SAME AS RPT. <input type="checkbox"/> DTIC USERS <input type="checkbox"/>			21. ABSTRACT SECURITY CLASSIFICATION Unclassified									
22a. NAME OF RESPONSIBLE INDIVIDUAL Nancy A. Perrigo Chief, STINFO Office			22b. TELEPHONE NUMBER (Including Area Code) (512) 536-3877	22c. OFFICE SYMBOL AFHRL/TSR								



**Unclassified**

**SECURITY CLASSIFICATION OF THIS PAGE**

**Item 18 (Continued):**

on-going research and development

publications and presentations

technical achievements FY83

weapon systems logistics, maintenance, and technical

**Unclassified**

**SECURITY CLASSIFICATION OF THIS PAGE**

**AIR FORCE HUMAN RESOURCES LABORATORY  
ANNUAL REPORT - FISCAL YEAR 1983**

**Edited by**

**Ruth M. Buescher**

**TECHNICAL SERVICES DIVISION  
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Chief, Technical Services Division**



## **AIR FORCE HUMAN RESOURCES LABORATORY**

A designated organizational element of the Air Force Systems Command, aligned under the Aerospace Medical Division.

**ALFRED A. BOYD, JR., Colonel, USAF**  
Commander

**DR. EARL A. ALLUISE**  
Chief Scientist

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### **ACKNOWLEDGMENTS**

Prepared by the Scientific and Technical Information Office (AFHRL/TSR) on the basis of the research and development efforts of the AFHRL scientists, engineers and associated contractors, with the assistance of numerous individuals from the AFHRL divisions and command and staff.

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and other anonymous Air Force photographers

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**CONTACTS:** A directory of AFHRL Command and Staff personnel and Division Chiefs is provided on the inside back cover. Points of contact are also given for each technical achievement and for each ongoing research and development project.

**NOTE:** The findings in this report are not to be construed as an official Department of the Air Force position unless so designated by other authorized documents.

Department of the Air Force  
**AIR FORCE HUMAN RESOURCES LABORATORY**  
Brooks Air Force Base, Texas 78235

**AIR FORCE  
AWARDS  
AFHRL  
OUTSTANDING  
UNIT AWARD**

**1 JAN. 1981  
31 DEC. 1982**



***"A vital element in keeping the peace is our military establishment. Our arms must be mighty, ready for instant action, so that no potential aggressor may be tempted to risk his own destruction."***

***Dwight D. Eisenhower***

***"We believe that the foundation for success depends on skilled, motivated Air Force men and women."***

***General Jerome F. O'Malley***

***"Man is and always will be the supreme element in combat, and upon the skill, the courage and the endurance, and the fighting heart of the individual soldier the issue will ultimately depend."***

***General Matthew Ridgway***

***"...a testimony to the importance of people as the single most important fundamental unit that we have."***

***Caspar W. Weinberger  
Secretary of Defense***

# AFHRL ANNUAL REPORT FY83

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# AFHRL

## MISSION

Principal Air Force Systems Command Organization for Planning and Executing Air Force Exploratory and Advanced Development Programs in:

1. Manpower and Personnel
2. Education and Training
3. Simulation and Training Devices
4. Logistics and Group Aspects of Human Factors

## ORIGIN

In the late 1960s, the Secretary of the Air Force and the Air Force Chief of Staff felt it necessary to redefine the Air Force's research and development (R&D) efforts in the related areas of personnel and training. In August 1967, the augmented Psychology and Social Sciences Panel of the USAF Scientific Advisory Board (SAB) conducted a study concerning such R&D work. In its report, the SAB developed certain standards needed for a successful program:

(a) the requirement for managers of these R&D efforts to possess and display a keen interest in the entire program, (b) the proper allocation of sufficient funding commensurate to the work being accomplished, (c) the acquisition and retention of well-trained and highly qualified people, (d) the recognition that the "human factor" involved in personnel and training R&D makes it a unique entity that cannot be compared to the hardware R&D in the Air Force's respective physical science laboratories, (e) the need for R&D functions to be geographically close to the organizations that most effectively applied the results of that R&D work, and (f) the need for a proper balance between finding solutions to current problems and the achievement of long-range R&D goals.

On July 1, 1968, the Air Force Human Resources Laboratory (AFHRL) was established with an organizational structure that has allowed it to effectively carry out its mission over the last 16 years.



Ronald W. Terry, Colonel, USAF  
Retired April 30, 1983

## MESSAGE FROM THE COMMANDER

Colonel Alfred A. Boyd, Jr.

I accepted command of the Air Force Human Resources Laboratory in early 1983 with a sense of high respect for this dynamic organization and an eagerness to meet the challenge of moving the Laboratory to even greater accomplishments in the future. Few professions offer the possibility of greater service and deeper dedication than the service of one's country. The defense of our country and the preservation of the freedoms our country provides evoke a kind of intrinsic motivation not encountered in many walks of life.

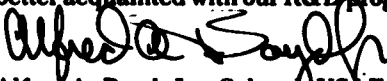
Being a research and development (R&D) laboratory, AFHRL personnel are not training for front-line battle duty, but the work of the Laboratory directly affects our nation's probability of combat success. We work to strengthen our forces, at the same time hoping that combat can be avoided. Our goal is peace through strength, and the Laboratory plays a key role in providing the instruments needed to acquire, train and support the human resources which are the source of that strength.

In 1982, General Gabriel, Air Force Chief of Staff, stated before the Senate Armed Services Committee that, "Attracting and retaining the right numbers and sufficient quality of skilled and motivated people is the principal challenge for the Air Force." To help the Air Force meet this objective, the Manpower and Personnel Division of AFHRL has a research program designed to improve ways to attract the most qualified individuals, assign them where they will be the most productive, and retain sufficient numbers in the career force to meet operational requirements.

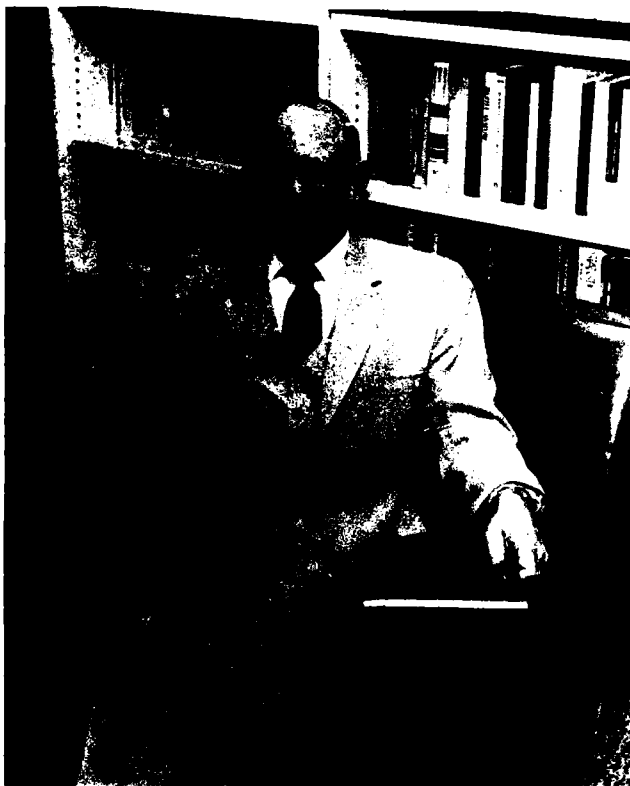


The Logistics and Human Factors Division provides the technologies to ensure the availability of functioning weapon systems to meet Air Force readiness needs. The Training Systems Division is designing experimental courses to develop, demonstrate, and evaluate improved instructional technology to provide increased combat readiness through state-of-the-art, cost-effective training. The Operations Training Division conducts R&D to improve combat effectiveness. This division is investigating pilot performance in simulated high-threat environments, providing combat experience otherwise unavailable in peacetime. The Technical Services Division supports AFHRL Command staff and the R&D divisions through management of information resources and the laboratory operations center.

This annual report highlights some of the features of our organization, programs, technical achievements and ongoing R&D projects of fiscal year 1983. We invite you to visit with us through this report, and to become better acquainted with our R&D programs and products.

  
Alfred A. Boyd, Jr., Colonel, USAF  
Commander

## CHIEF SCIENTIST'S REPORT



**Dr. Earl A. Alluisi**

During FY83, the Laboratory experienced only relatively minor changes in its program structure and resource alignments. Among the greater of these were the creation of two thrusts, and two divisions to manage them, out of the former Weapon Systems Logistics, Maintenance, and Technical Training thrust and Logistics and Technical Training Division. Thus, with four major research and development (R&D) thrusts, and four corresponding divisions charged with the technical management of the thrusts, the Laboratory continued to develop technology for Air Force use in acquiring, training, and managing the highly capable personnel force required for its weapon systems to be operated and supported in ways that ensure combat success.

Between the Executive Summary and the final sections that present details of the Laboratory's organization and resources, the main body of this report presents the technical achievements and ongoing R&D in terms of the four major program thrusts as follows:

(1) The Maintenance and Combat Support thrust is developing technology for acquisition, combat

logistics, and team training systems. The technology facilitates the integration of manpower, personnel, training, and logistics factors into weapon systems design and acquisition. The emphasis has been on computer-aided design for weapon systems development, supportability, and maintainability, and on automated performance aids for battle damage repair. In addition, this thrust focuses on team training and performance in command and control battle-management functions.

(2) The Training Design and Delivery thrust is developing technology to guide in the design and acquisition of computer-based training management and delivery systems applicable to both "schoolhouse" and "on-the-job" training. At more fundamental levels, it is developing technology for relevant skill and performance specifications, as well as for technology for applications of artificial intelligence in technical and maintenance training and performance.

(3) The Manpower and Force Management thrust provides technology for the effective acquisition, distribution, and management of the personnel force, military as well as civilian. The challenge for the technology is to provide the means for making the best person-job-matches possible on an ongoing basis--not a trivial task considering the size of the Air Force (over 575,000 uniformed personnel and nearly 250,000 civilians in 1983), as well as the impacts of economic, social, and political factors on manpower availability.

(4) The Aircrew Training thrust provides engineering technology for flight simulators and training technology for the effective use of these simulators in acquiring and maintaining combat flying skills. The aim is to provide training-effectiveness data and technology through the use of which aircrews can be trained in peacetime to perform combat missions with the same expertise and success as combat veterans.

Technical Evaluations. There were many management reviews of the Laboratory and numerous technical reviews of parts of the program during FY83, as there are every year. There was one major technical review aimed to assess the quality of the entire program and its technical soundness. This technical review, scheduled as an annual event, is conducted through the AFHRL Technical Advisory Board (TAB), which consists of the Technical Directors of the four R&D divisions, the Chief

Scientist as chair, and a secretary. The TAB is assisted by a different Research Advisory Panel (RAP) for each thrust. Each RAP consists of three or more scientists of international repute in the thrust's relevant substantive areas, but drawn from outside the Department of Defense. Each TAB technical review involves week-long meetings with division personnel, including especially the task scientists actually conducting or monitoring the work. The "third round" of TAB technical reviews, which were conducted during FY83, were judged the most successful to date, but capable of being improved further with increased technical (as contrasted with management) details and more time for interactions with task scientists. The fostering of integration across the program thrusts was again cited as one of the additional benefits of the TAB technical reviews.

Technical Status of the Maintenance and Combat Support Thrust. The program in this thrust was judged to be developing with high technical quality in all three of its areas--acquisition logistics, combat logistics, and team training and performance in command and control. In the two logistics R&D areas, the program emphasis clearly appears to be on applications, and it was recommended that the emphasis should be broadened to include more of the R&D issues that are in the Laboratory's mission. The team training area, as reviewed, appears to be contributing importantly to the command and control area, but to be aimed at addressing too few of the more general team-training R&D issues; this was viewed as a potentially serious shortcoming in the approach, and it was recommended that the issue be further reviewed at management levels.

Technical Status of the Training Design and Delivery Thrust. The program in this thrust was still in the formative stages at the time of the TAB technical review. Heading towards completion were major projects on standardized computer-based-instruction (CBI) software and maintenance simulation for training. The CBI software efforts were judged to be "on track," having been joined into a joint-Services R&D project with the common goal of providing a library of transportable, user-friendly, menu-driven, machine-independent, modularized, course-authoring CBI software, in Ada, for use by all the military Services; this effort, as well as the numerous technology-transition projects based on it, were highly commended. It was recommended that the maintenance simulation efforts, scheduled to be completed during FY84, be devoted to documenting the findings and lessons learned, for example in both technical reports and guides or specifications for the design, acquisition, and use of maintenance

simulators for training. Three additional areas were reviewed with projects in their formative stages, and specific recommendations were made to ensure the technical quality of the proposed work; specifically, the (a) Integrated Training System, (b) Manpower, Personnel, and Training Integration Technology, and (c) Application of Artificial Intelligence to Air Force Training efforts. The TAB also observed that there are several common elements in the proposed work that require continuous and close technical coordination with similar efforts in the Manpower and Force Management thrust; for example, the (a) development of task lists, (b) determination of training requirements, and (c) development of job-performance measures.

Technical Status of the Manpower and Force Management Thrust. Although the technical quality of the efforts in this thrust was judged extremely high in all cases, the TAB cautioned that it continues to be endangered by having minimum resources assigned to the R&D--that is, the technical quality of the program could be jeopardized, or even compromised, by removal of just a few persons because the depth of expertise in several areas is critically low. The basic research program was singled out for commendation, but with the caution that care should be exercised to ensure that it does not grow beyond the available resources, and with the recommendation that it be more actively integrated with efforts in the Laboratory's other R&D thrusts. In the area of personnel-qualification testing, the TAB observed that numerous R&D efforts must be completed to meet the Laboratory's responsibilities for the Air Force (which is the Executive Agency for R&D on the Armed Services Vocational Aptitude Battery, or ASVAB), and that the technical quality of ASVAB R&D is affected not only by the AFSC/AMD/AFHRL chain of command, but also by program directives coming from multiple sources external to this chain--for example, the ASVAB Steering Committee, the ASVAB Working Group, and the Defense Advisory Committee for Military Personnel Testing. In order to obviate, or at least reduce, problems that threaten to compromise the technical quality of the R&D program in this area, the TAB recommended that consideration be given to having a prime contractor develop routine revisions of operational tests as well as the psychometric analyses, norming, and standardization that are necessary parts of such cyclic test development.

Technical Status of the Aircrew Training Thrust. Major efforts were taken in both management and technical spheres to integrate the two aspects (training and simulation, or behavioral and engineering) of this thrust. The beneficial effects of these efforts were

quite evident in terms of the improved technical quality of the work proposed for FY84. Nevertheless, the FY83 program was judged still imbalanced, with engineering-development goals primary and training-R&D goals seemingly secondary. To strengthen the technical quality of the overall program, the TAB recommended that additional planning of training (behavioral) R&D precede initiation of engineering-design projects. Overall, the training R&D was judged too narrowly limited to the single strategy of testing the training effectiveness of devices-in-being through relatively simple, "purely applied-research" experiments. Alternative training-R&D strategies (e.g., skill-acquisition and skill-maintenance training R&D), the results of which would guide the design and development of training devices in the context of aircrew-training systems, were too little in evidence. Technically sound plans were presented for both the behavioral and the engineering aspects of the R&D programs, but whereas the engineering plans were detailed and comprehensive, the training-R&D plans lacked comprehensiveness and detailed specifications. The TAB recommended that training-effectiveness issues be more directly addressed--i.e., that training-R&D plans be more fully developed and engineering-R&D plans designed to support the training R&D, with both fully integrated into single plans oriented towards the thrust's objectives.

**Technical Overview.** As a result of the TAB technical reviews, and in addition to the items addressed in specific thrusts, certain gaps, opportunities, and

unresolved issues affecting the program on a Laboratory-wide basis became apparent.

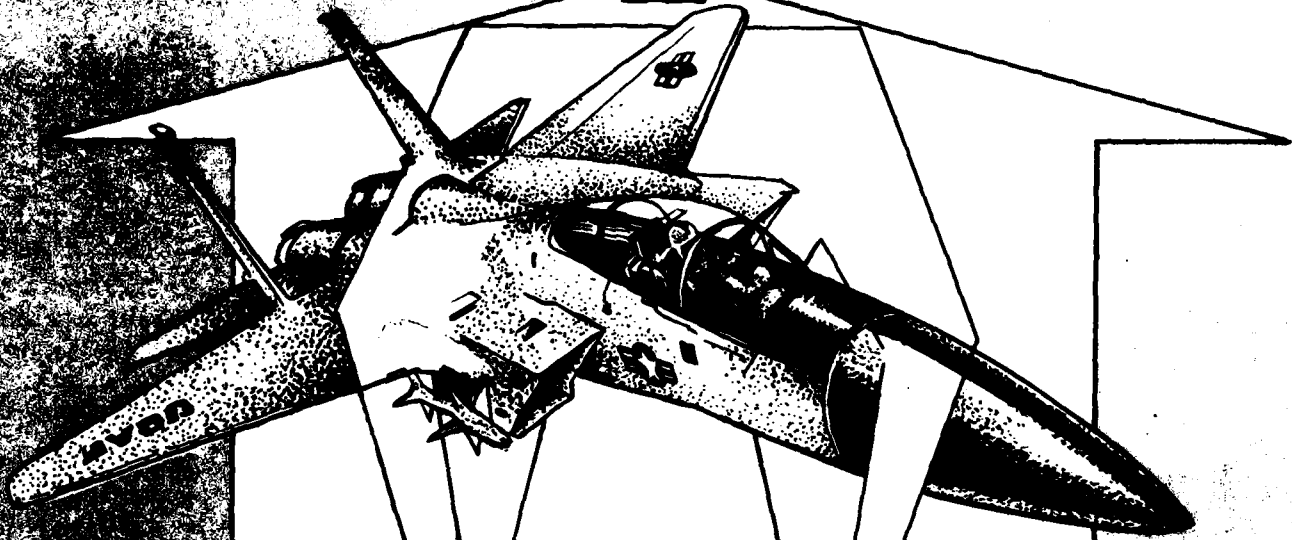
(1) The principal gap is in in-house 6.1 (Research) and early 6.2 (Exploratory Development) efforts.

(2) The greatest unfulfilled opportunity is to achieve real program integration across divisions (and even other laboratories) in the several efforts that are suitably large, cohesive, and important, for example in the advances being planned in artificial intelligence.

(3) The most apparent Laboratory-wide unresolved issue is that of establishing a suitable mechanism for technology transfer, for transition of Laboratory products into utilization--some institutionalized mechanism to move vertically integrated technology demonstrations that are field deployable from the Laboratory through 6.4 (Engineering Development) at a product-division level to operational use.

**General Comments.** An annual report provides a static picture--the status at a point in time--of the very dynamic program which is, in the final analysis, the very substance of the Laboratory. The directions of a program are at least as important as its current status. And here the evaluation is clear: The direction is proper--to develop and apply the technology base and advanced technology demonstrations to increase the probability and ease of combat success.

# COMBAT SUCCESS



MANPOWER &  
FORCE MANAGEMENT

AIRCREW TRAINING

TRAINING DESIGN &  
DELIVERY

MAINTENANCE &  
COMBAT SUPPORT

RDT & E

THE  
GENERAL TECHNOLOGY BASE

# MAINTENANCE AND COMBAT SUPPORT THRUST

## R&D DIRECTIONS

### FY84 WORK

- TOTAL AVIONICS SYSTEMS
- ARTIFICIAL INTELLIGENCE
- INTERMEDIATE SHOP TEST
- INTEGRATED SYSTEMS FOR FLIGHT LINE
- PROTOTYPE, AIRCRAFT BATTLE DAMAGE REPAIR ASSESSMENT AID

- IDENTIFY COMBAT MAINTENANCE TASKS
- MODEL NEW LOGISTICS CONCEPTS

- COMBAT DATA BASE
- ELECTRONIC COUNTERMEASURES DEMAND METHODOLOGY
- INTEGRATED COMBAT DEMAND RESOURCE REQUIREMENTS

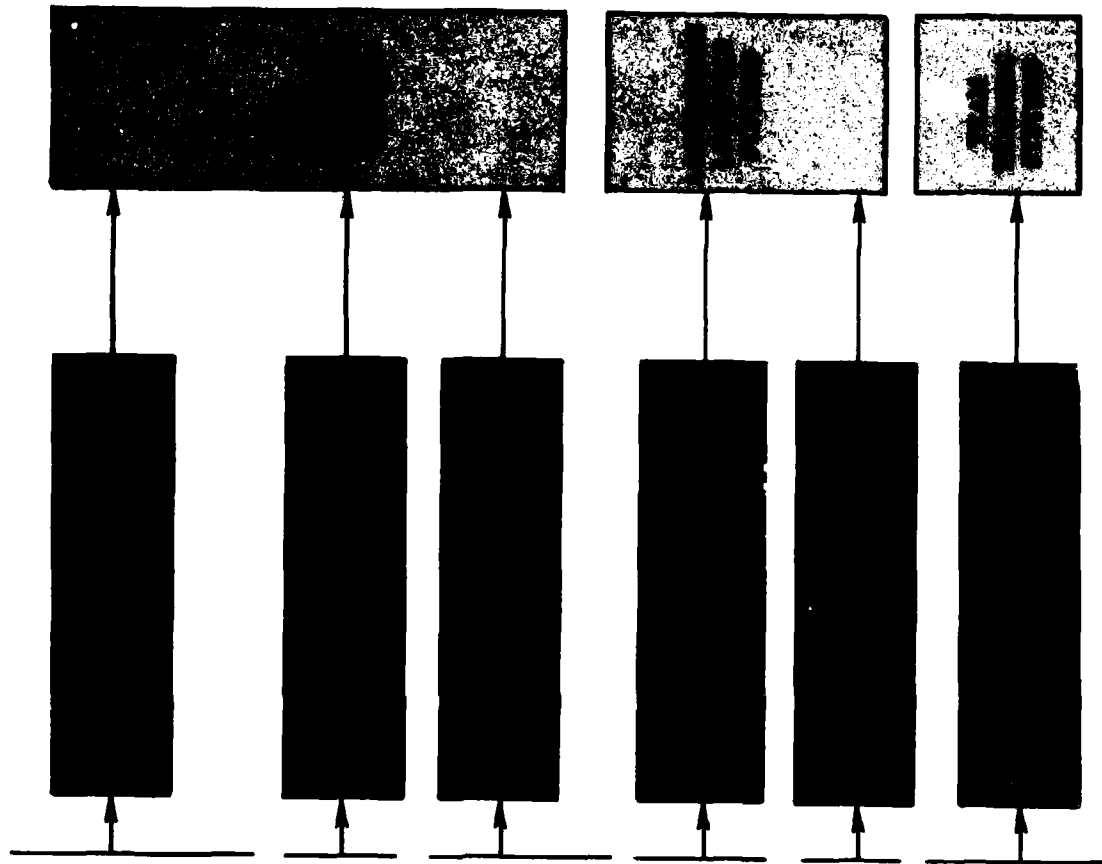
- MAINTENANCE & LOGISTICS ANALYSIS MODELS
- BIOMECHANICAL MODEL
- MAINTENANCE TECHNICIAN
- COMPUTER-AIDED DESIGN
- SYSTEM INTEGRATION

- ANALYSIS MODEL FOR NEW AVIONICS
- DEVELOP/INTEGRATE FULL UNIFIED DATA BASE

- COMMAND & CONTROL DECISION EXPERIMENTS
- COMMAND & CONTROL
- TEAM TRAINING METHODS
- MICROPROCESSOR TRAINING SYSTEMS

### COMPONENTS

### SUBTHRUSTS





## EXECUTIVE SUMMARY

This Annual Report presents the organization and activities of the Air Force Human Resources Laboratory (AFHRL) for FY83. The Laboratory's activities are reported as Technical Achievements and as Ongoing Research and Development (R&D) as determined by the degree of completeness of the project. Additionally, the activities are presented in terms of the Laboratory's major thrusts and subthrusts: Diagrams highlighting the R&D thrusts (Maintenance and Combat Support, Training Design and Delivery, Manpower and Force Management, and Air Crew Training) and their subthrusts are presented to provide the context for the descriptions of specific projects.

The Maintenance and Combat Support R&D thrust was the responsibility of the Logistics and Human Factors Division located at Wright-Patterson AFB, Ohio. Combat Logistics Systems, Acquisition Systems, and Team Training Systems are its three subthrusts. Under the Combat Logistics Systems subthrust, efforts focused on computer-aided design for weapon systems development, supportability, and maintainability. Results on one project indicated that the aerospace industry desired the Air Force's role to be one of setting standards, developing databases and models, and sponsoring the growth of maintenance oriented computer-aided design. Another effort is developing computer-based maintenance aids for technicians.

Under the Acquisition Systems subthrust, the R&D program was directed toward analyzing the maintenance environment, examining Air Force combat maintenance capability, determining wartime demand rates for aircraft electronic countermeasures equipment, and developing an automated aid for assessing aircraft battle damage. AFHRL findings have allowed both maintenance managers and the R&D community to concentrate limited funds and manpower to finding solutions to those problem areas which are most serious and have the greatest chance of payoff. Another project developed methods by which the Air Force measures, quantifies, and improves its combat maintenance capability. Repair of aircraft battle damage will be greatly facilitated through use of the automated battle damage assessment aid which is under development.

R&D within the Team Training Systems subthrust focused on the improvement of command and control for battle management. In one effort work was directed toward determining the technical requirements for establishing high fidelity tactical command and control training and evaluation capability. Another effort was designed to expand both the empirical and theoretical base of command and control decision-making technology and to apply this knowledge to the training and evaluation of command personnel. With the proper training, the users of improved Command and Control Centers will have the ability to operate smoothly and efficiently in combat and in a rapidly changing tactical environment.

# TRAINING DESIGN AND DELIVERY THRUST

## R&D DIRECTIONS

### FY84 WORK

- TRAINEE EVALUATION INSTRUMENTS
- POSITION TRAINING REQUIREMENTS
- MASTER TASK LISTS

- GRAPHICS SIMULATION
- DESIGN HANDBOOKS
- INSTRUCTIONAL SUPPORT SOFTWARE

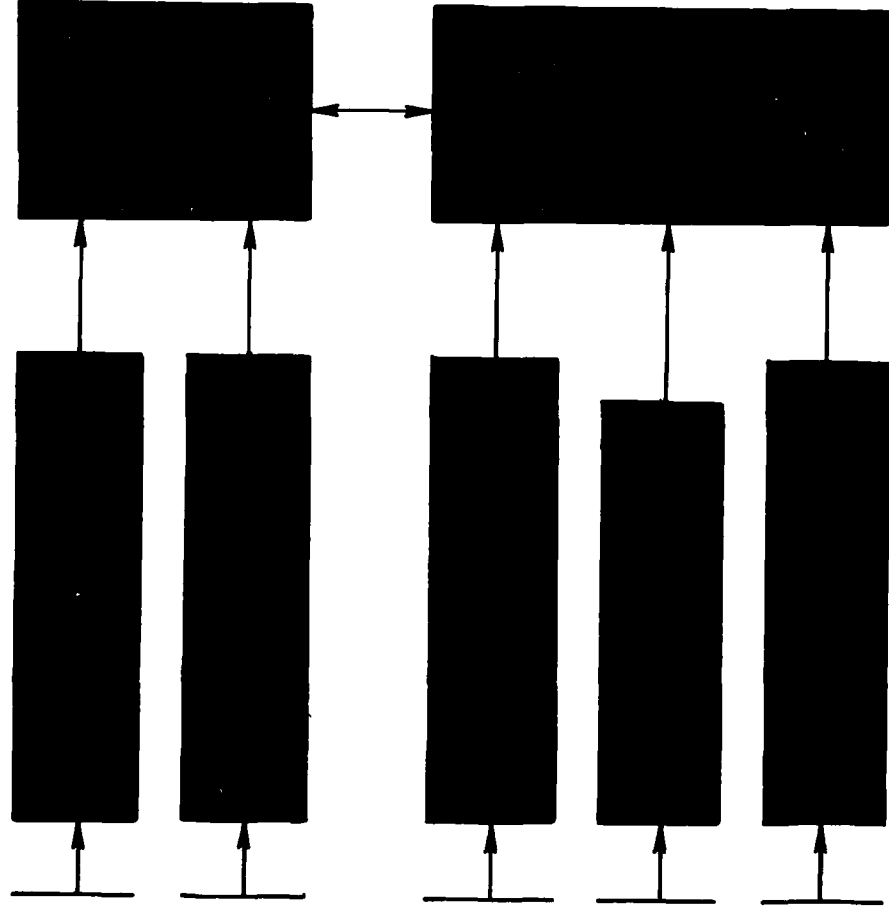
- TRAINING REQUIREMENTS DEFINITION
- PERFORMANCE MEASUREMENTS
- TRAINING MATERIALS

- GRAPHICS SIMULATION EVALUATION
- MEASUREMENT/ANALYSIS OF JOB REQUIREMENTS

- ARTIFICIAL INTELLIGENCE APPLICATIONS IN TESTING & TROUBLESHOOTING
- GENERIC DIAGNOSTIC TRAINING TOOLS
- MAINTENANCE DIAGNOSTIC AND TRAINING SYSTEMS DEMONSTRATION

### COMPONENTS

### SUBTHRUSTS



The Training Design and Delivery R&D thrust was managed by the Training Systems Division located at Lowry AFB, Colorado. This thrust has two subthrusts--Training Management and Delivery Systems, and Skills and Performance Specification Systems. Under the Training Management and Delivery Systems subthrust, a detailed set of specifications was developed for an ultrasonic non-destructive inspection (NDI) trainer. These specifications will enable user agencies to acquire a prototype trainer. In another effort, a prototype trainer for flight simulator troubleshooting was developed; its value in training flight-simulator maintenance technicians is being tested. During FY83, the Laboratory transitioned its computer-based instructional technology widely both within and outside the Air Force. The developed instructional support software is being converted into a standard high-order language, Ada, to increase its availability and utility. This is one of the Laboratory's contributions to a joint-Services effort to develop a family of hardware and software to support computer-based instruction in a variety of military training and educational applications. Another project resulted in

an operational computer-assisted daily flight scheduling capability. Other R&D focused on developing specifications for the design of maintenance simulators, as well as developing computer graphics simulation of maintenance tasks. The potential of interactive graphics simulation to facilitate both learning and troubleshooting skills practice provides a cost-effective alternative to costly, unreliable, and labor-intensive actual equipment training.

Under the Skills and Performance Specification Systems subthrust, AFHRL investigated the roles and behaviors of instructors engaged in non-conventional instruction. A role model was developed and recommendations given for training and utilizing instructors in non-conventional instruction. By emphasizing the use of instructors in the designated ideal roles and behaviors and assigning remaining functions to non-instructor personnel, training for instructors can be more specific in preparing them to function effectively on the job.

# MANPOWER AND FORCE MANAGEMENT THRUST

## R&D DIRECTIONS

### FY84 WORK

- LATENT TRAIT & TEST EQUATING METHODOLOGY
- OPERATIONAL TESTS
- ITEM BANKS
- SPECIALIZED TESTS, NORMS & CONVERSION TABLES

- JOB DEMANDS: APTITUDE, STRENGTH & STAMINA, BASIC SKILLS
- OCCUPATIONAL DATA BASE
- CODAP EXTENSIONS

- HISTORICAL AIRMAN DATA BASE
- ENLISTED LABOR SUPPLY MODEL
- TRAINING DECISIONS SYSTEM
- MEDICAL SCHOLARSHIP SELECTION
- PERSON-JOB MATCH ALGORITHMS
- PROJECTION MODELS

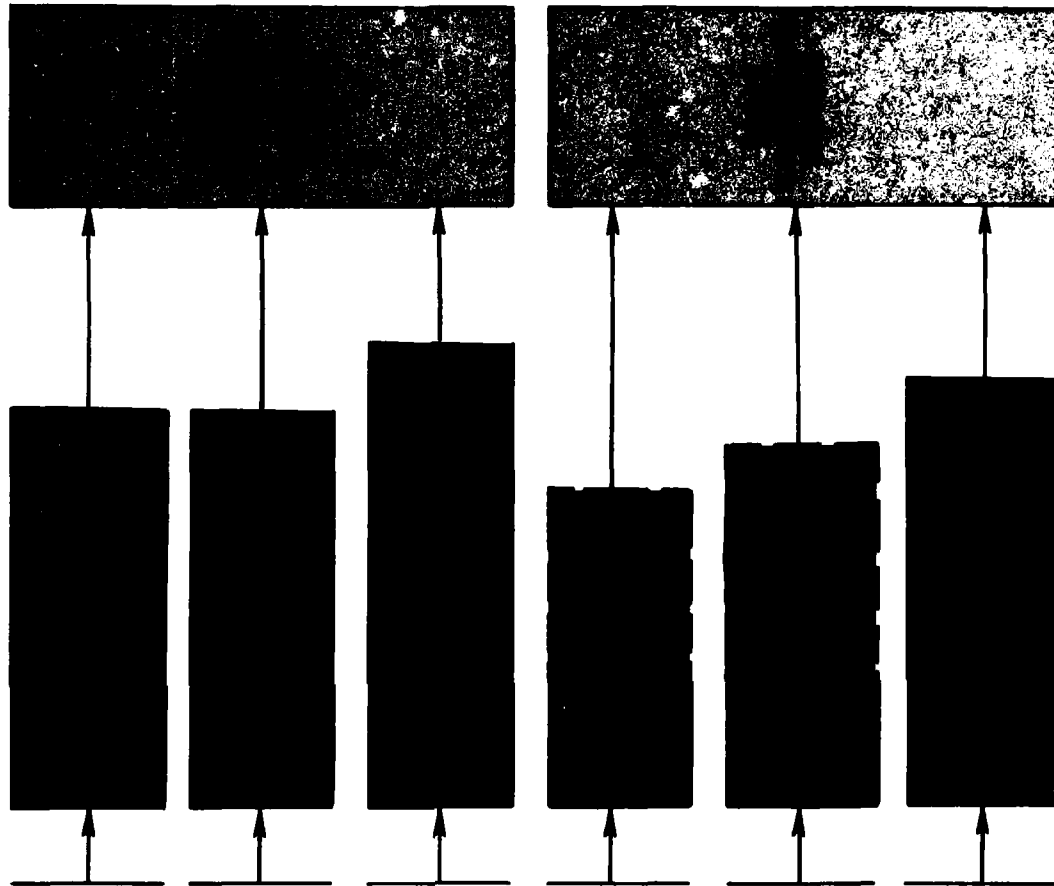
- ADAPTABILITY INVENTORY
- PROTOTYPE TURNOVER MODEL

- RETRAINING GUIDES

- PRODUCTIVITY MEASURES & INCENTIVE SYSTEM
- PERFORMANCE DATA BASE
- MEASUREMENT TECHNOLOGY

### COMPONENTS

### SUBTHRUSTS



The Manpower and Force Management R&D thrust is divided into the Force Acquisition and Distribution System subthrust and the Force Management subthrust. The Force Acquisition and Distribution System subthrust covers a great variety of projects.

Alternative weighting systems for the Weighted Airman Promotion System (WAPS) were developed.

As a result of this development policymakers have several alternatives available to improve WAPS, further ensuring that the most deserving airmen are promoted to grades E-5 through E-7. The Comprehensive Occupational Data Analysis Programs were initially developed in response to the need for an efficient and effective method of identifying and classifying jobs in a rapidly changing Air Force.

These programs were enhanced, upgraded, and expanded during FY83. Estimation of Air Force enlisted manpower supply was continued to determine the impact of changes in civilian and military economic and policy parameters on the distribution of enlisted personnel by specialty, experience, and aptitude. Projections were made of skill requirements to ensure that manpower is appropriate to the Air Force mission and that personnel are available in sufficient quantities with the proper skills to accomplish mission requirements. Validation studies continued on the selection systems for Officer Training School and the Air Force Reserve Officer Training Corps, as well as on selection procedures for pilot/navigator training.

Ongoing projects have added information about pilot candidates' psychomotor skills to the existing selection decision variables, i.e., the Air Force Officer Qualifying Test (AFOQT) and the Flight Screening Program. Preliminary results indicate that the integration of these measures of perceptual motor skills with the existing decision variables could reduce pilot training attrition by 4-5%. Efforts are continuing on a training decisions system to provide readily available and validated information to the Air Staff and user commands on costs and consequences of training decision alternatives under different

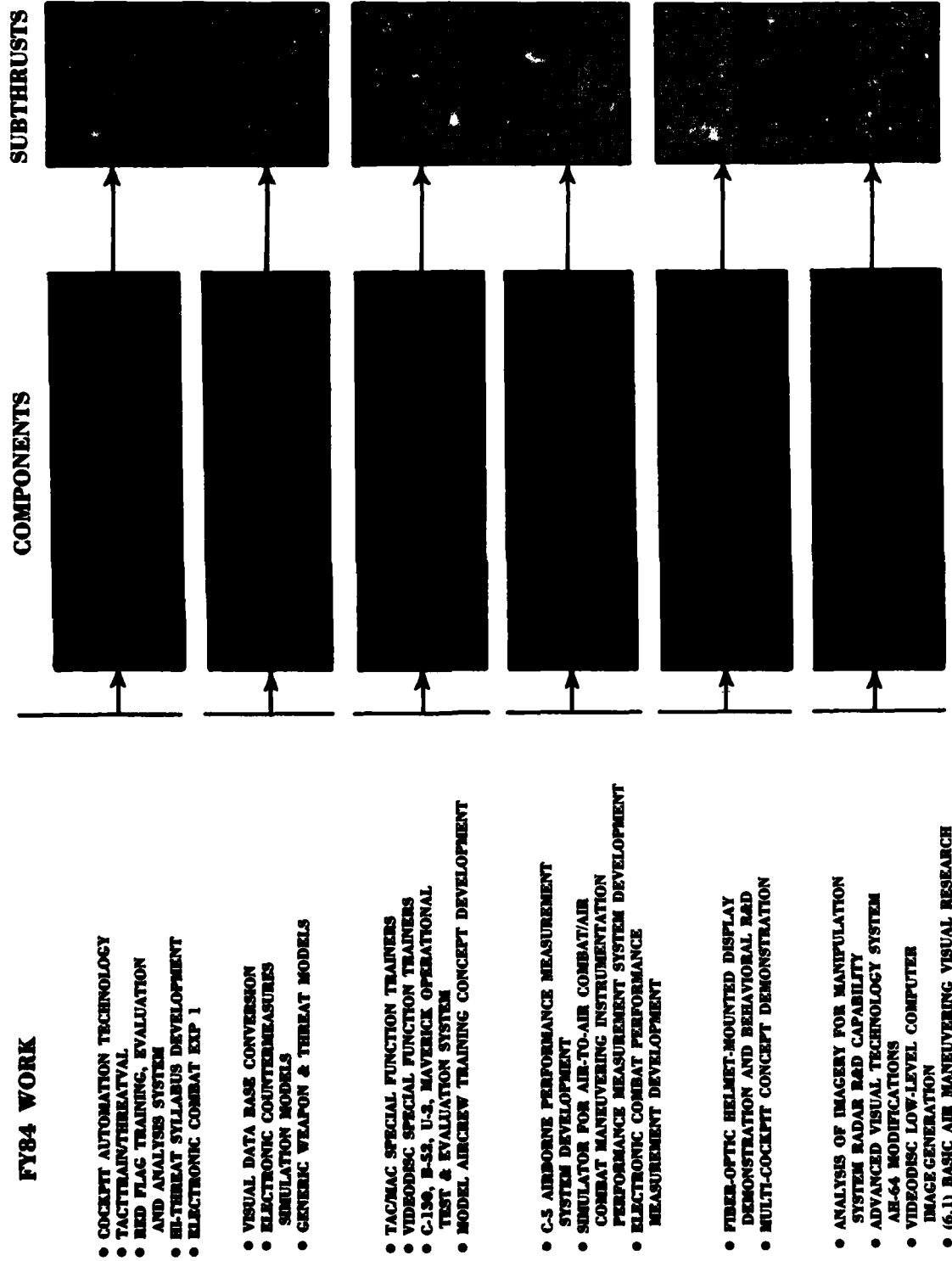
constraints, costs, and personnel utilization patterns. Work continued on adaptive testing, as well as on the assessment of physical strength and stamina requirements in Air Force specialties.

Development and validation efforts continued on the Air Force Officer Qualifying Test, and the Armed Services Vocational Aptitude Battery. To determine the impact of the Armed Services Vocational Aptitude Battery, AFHRL estimated the cost avoidance that occurs through its use. Based on conservative assumptions, the attrition rate without use of the ASVAB was estimated to be 14% greater than it is with selection based in part on the ASVAB results. To obtain the same number of graduates, an additional 7326 airmen would be needed at an additional total training cost of \$36,630,000 per year. Since the Air Force has only 20 percent of the total Armed Services personnel, this estimation could be multiplied by five to estimate the DOD-wide cost avoidance in training dollars through use of the Armed Services Vocational Aptitude Battery.

Under the Force Management Systems subthrust, empirically based information and guidelines were completed for improving the current system of retraining enlistees from one occupational specialty to another. Work continued to provide objective feedback on actual job performance in the mechanical career fields. If this prototype system is successful, this methodology will be applicable to a full range of functional specialties. R&D is ongoing to determine how feedback, goal setting, and incentives enhance productivity of Air Force personnel. Another project involved a longitudinal assessment of stay/leave decisions of Air Force personnel. This R&D effort will provide information for making informed accession and personnel management policy decisions which should result in the ability of the Air Force to retain more of its experienced and productive personnel by making the Air Force a more attractive career option.

# AIRCREW TRAINING THRUST

## R&D DIRECTIONS



The Aircrew Training R&D thrust is divided into the Aircrew Training Systems, Aircrew Training Applications, and the Technology for Aircrew Training Simulation subthrusts. Under the Aircrew Training Systems subthrust, R&D was conducted to determine field-of-view requirements for selective air-to-air and air-to-ground maneuvers. As the amount of visual information presented in a flight simulator display is increased, so are the costs. Therefore, the training payoff of the amount of visual data required must be clearly defined. Another effort focused on the potential threat to aircrew survivability, as well as the effects on both offensive and defensive aspects of the close-air-support mission associated with temporary loss of visual cues that might result from the laser "flash effect." One project investigated the effects of alternative visual cue displays on pilot performance in a simulated low-level flight task.

Under the Aircrew Training Applications subthrust, R&D was conducted to measure the relationship between aircrew performance in the simulator and their subsequent performance in the actual aircraft, through the development of an integrated aircrew measurement system, for use on the ground and in the air. Another project was designed to develop measures of electronic combat performance and to use them to evaluate the effectiveness of current electronic combat training. Efforts were directed toward developing and evaluating programs for training C-5A and C-141B pilots and copilots in aerial refueling tasks using ground-based part-task trainers. In another project, efforts were directed to develop and evaluate a microcomputer-based Aircrew Training Management Information System to document,

process, and provide summary reports of the data obtained on each student pilot during F-15 training.

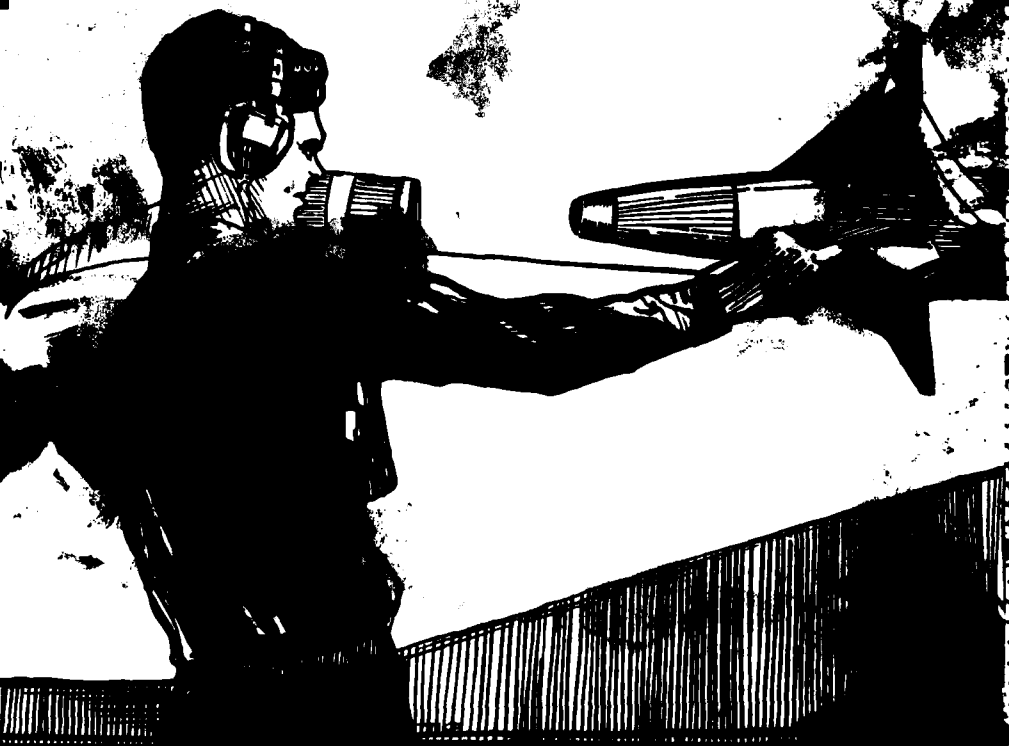
Under the Technology for Aircrew Training Simulation subthrust, a low-altitude navigation and targeting infrared for night attack system (LANTIRN) has been initiated. The LANTIRN system will provide a full-mission trainer for all aircraft systems and weapons delivery. Pilots using the LANTIRN system will be able to fly their missions in the simulator with a higher degree of safety and greater precision. Other ongoing projects will (1) determine the imagery requirements for future radar simulation systems, (2) develop a lightweight visual image display system consisting of collimating plastic Fresnel lenses that should provide enhanced light transmission for simulator visual displays, (3) extend videodisc visual system technology, (4) develop a variable acuity display system, (5) refine the currently used fiber-optic helmet-mounted display, and (6) complete development of a Combat Mission Trainer.

After the technical achievements and ongoing R&D are presented, this report reviews the ongoing projects through which the Technical Services Division supports the other divisions and outside agencies. Some of these are the general purpose development program, the file item data organizer, and the human resources research database.

This report describes other AFHRL functions, systems and facilities. It reports special events of FY83 and presents AFHRL organization, resources, and publications.



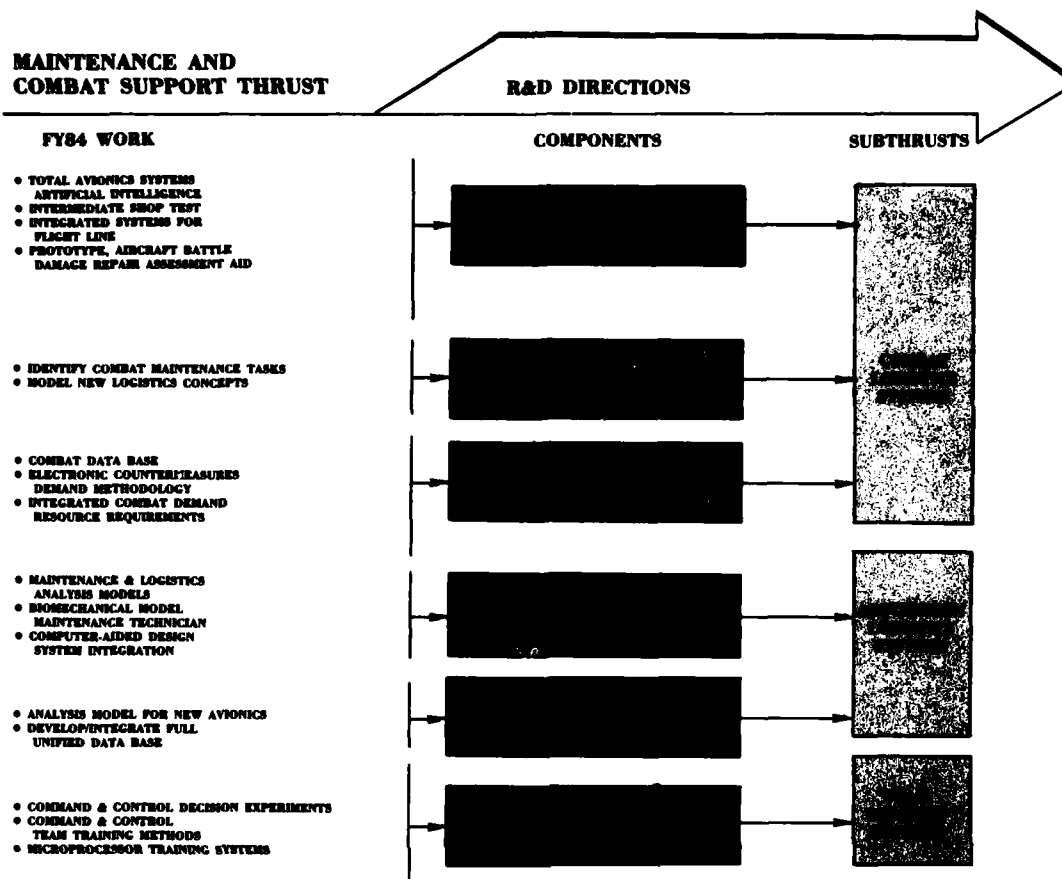
# MAINTENANCE COMBAT SUPPORT



LABORATORY



## MAINTENANCE AND COMBAT SUPPORT THRUST



## COMBAT LOGISTICS SYSTEMS

## TECHNICAL ACHIEVEMENTS

### Title: Computer-Aided Design: Industry Survey

**AFHRL Contact:** William B. Askren  
 AFHRL/LRA  
 Wright-Patterson AFB OH 45433  
 Commercial (513)255-3871  
 AUTOVON 785-3871

**Description:** A survey was conducted of 17 aerospace companies to determine current and desired inclusion of maintenance functions/issues in the design of systems and equipment, with emphasis on inclusion of computer-aided design (CAD). The results, compiled from data collected during visits to these companies, indicate a broad scope of maintenance functions/issues now being included in design or planned for inclusion in future design. The results indicate also that the aerospace industry desires that the role of the Air Force be one of setting standards, developing databases and models, and sponsoring the growth of maintenance-oriented CAD.

**Utilization:** The results of the survey are being used three ways: (a) to help formulate AFHRL's R&D plans in the area of maintenance and logistics factors in CAD, (b) to serve as the basis for AFHRL input to the Institute for Defense Analysis study on reliability and maintainability (R&M) factors in CAD, and (c) as planning information for a new tri-Service committee on R&M in CAD.

**Benefits:** The information and data collected during the survey have significantly reduced planning time for the new effort and have impacted the scope and content of the follow-on work.

**Title: Computer-Aided Design: A Tool for Supportability**

**AFHRL Contact:** Alan E. Herner  
AFHRL/LRA  
Wright-Patterson AFB OH 45433  
Commercial (513) 255-3871  
AUTOVON 785-3871

**Description:** Computer-aided design (CAD) has great potential to improve the supportability of weapon systems. As part of their ongoing effort to improve the logistic characteristics of weapon systems, AFHRL helped to document a contractor's independent research and development project. The videotape produced as part of this effort shows a number of potential uses of CAD to address reliability and maintainability (R&M) and logistics in the design phase.

**Utilisation:** The videotape has proven very useful in educating people to the great potential of CAD to address R&M issues. It is now being used as part of the curriculum at the Defense Systems Management College.

**Benefits:** The work described in the videotape forms the foundation for major maintenance and logistic factors consideration in a CAD demonstration on the Ground-Launched Cruise Missile to be done in FY85.



Computers Aid in Weapon Systems Design

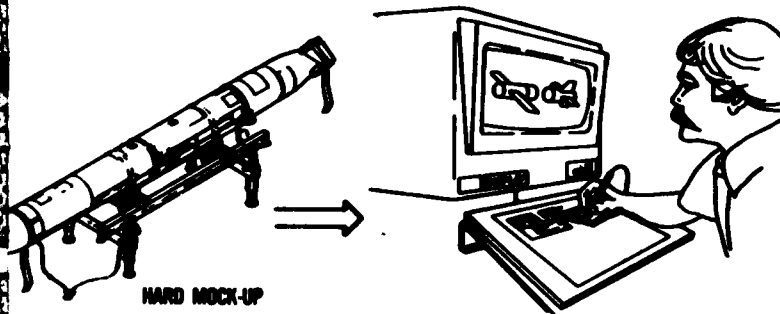
**Title: Maintainability in Computer-Aided Design**

**AFHRL Contact:** Capt Dennis F. Spray  
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**Description:** This R&D project demonstrates the feasibility of including maintainability analysis in computer-aided design (CAD) during the conceptual design phase of Air Force weapon systems acquisition. The principal product is a two-dimensional graphic depiction of a maintenance technician performing various tasks in different body positions on an F-15 aircraft. Since the aircraft representation includes avionics equipment and access panel locations, it permits accessibility analysis from the technician's perspective.

**Utilisation:** This R&D promotes injecting maintainability analysis into the early stages of weapon systems design.

**Benefits:** This interface of maintainability analysis with CAD permits on-the-spot corrections and changes while significantly reducing the time and requirement for drafting the design. Weapon systems design flexibility prior to formalization avoids expensive engineering changes later in the acquisition cycle. Thus, the Air Force is assured of fielding highly maintainable weapon systems at a lower cost.



Computer-Aided Design Representation  
Replaces Hard Mock-Up

## COMBAT LOGISTICS SYSTEMS

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**Title:** Logistics Analyses for the Integrated Communication Navigation Identification Avionics System

**AFHRL Contact:** James C. McManus  
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Commercial (513) 476-2018  
AUTOVON 986-2018

**Description:** The objective of this effort is to identify tools and techniques for incorporating logistics engineering parameters into system design during the conceptual phase. These analysis techniques will be demonstrated by applying them to the front-end analysis portion of the Integrated Communication Navigation Identification Avionics (ICNIA) system conceptual phase. Among the unique problems being addressed is the development of reliability-analysis techniques for graceful degradation. The work will include four major tasks applied to two conceptual ICNIA system architectures developed by the Air Force Avionics Laboratory. Incorporated into these tasks is a front-end analysis to determine the problems associated with logistics engineering during the conceptual development of new avionics and to identify the techniques needed to accomplish logistics analysis. The major tasks involve developing front-end analysis techniques in the areas of logistics support, reliability, survivability, and fault tolerance and applying them to the architectures of the two ICNIA systems. A users handbook and supporting guidance documentation for programming will be prepared, addressing the rationale and logic behind the analyses identified and developed. The documentation provides sufficient detail and clear guidance for use of these analyses. Computer programs will also be prepared for the mission-reliability model developed under this effort.

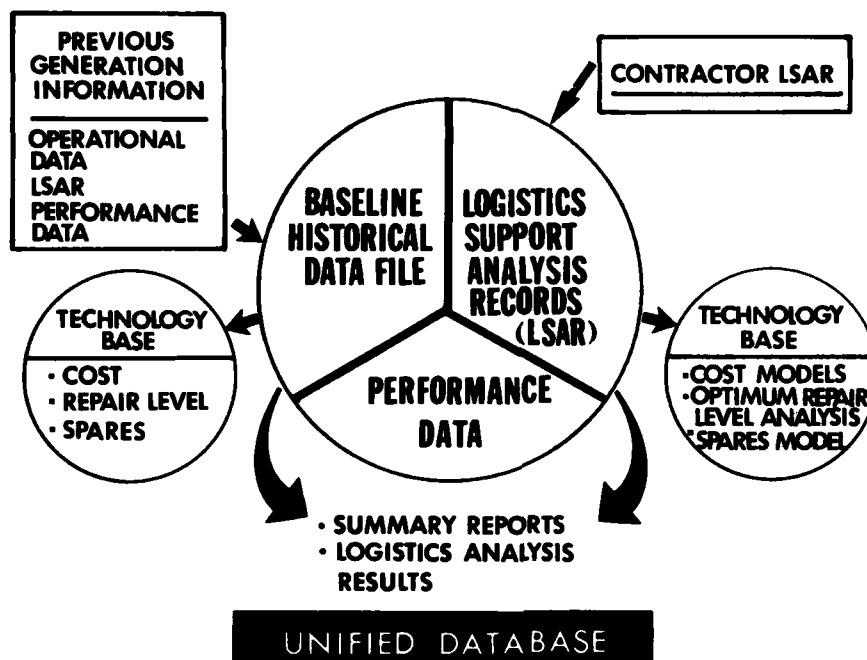
**Utilization:** The results of this effort will provide guidance concerning analysis techniques plus indicators of logistics support, reliability, and survivability for the two ICNIA system architectures. The technology and the analysis technique developed will be used by government and industry engineers to evaluate the impact that various conceptual design elements will have on equipment reliability, maintainability, and survivability.

**Title:** Computer-Based Maintenance Aids for Technicians

**AFHRL Contact:** David R. Gunning  
AFHRL/LRC  
Wright-Patterson AFB OH 45433  
Commercial (513) 255-2606  
AUTOVON 785-2606

**Description:** A prototype computer-based maintenance aids system is being developed that will store, retrieve, and present information for use by technicians who perform maintenance tasks at the intermediate level. The goal is to develop a system that is easy to use, is liked by technicians, and provides all of the information needed for the task. Human factors requirements are being emphasized in the system design. The system will present instructions at three levels of detail. This feature will provide technicians with instructions that are appropriate for all levels of experience (very detailed instructions for inexperienced technicians, less detailed instructions for more experienced technicians). The prototype is now being constructed and will consist of a graphics terminal and a minicomputer that will be installed at an intermediate level B-52 aircraft maintenance shop at Dyess AFB, Texas. There the prototype will be evaluated by measuring the effectiveness of technicians using the system in performing maintenance on a test-bed system.

**Utilization:** The results of the evaluation will be used to develop system specifications for the procurement of technical data for future weapon systems. The B-1B and the Advanced Tactical Radar program developers are interested in using the specifications to procure automated technical data systems. In addition, the technology developed in this project will provide the basis for developing an effective technical data presentation system for The Automated Technical Order System of the Air Force Logistics Command. The operational use of a computer-based maintenance aids system will significantly reduce the costs of maintaining the technical order system by reducing the cost of updating technical data as well as printing costs.



**Title:** Unified Database Technology

**AFHRL Contact:** Robert N. Deem  
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Wright-Patterson AFB OH 45433  
Commercial (513) 255-3871  
AUTOVON 785-3871

**Description:** A unified database (UDB) technology is being developed for a central automated source of logistics data drawn from basic Air Force systems to support the weapon systems design process. Logistics data are those that would assist in obtaining answers to questions about logistics requirements as a function of alternative design/support concepts. Logistics data relate directly or indirectly to reliability, maintainability, ground-support equipment, built-in test equipment, task analysis, skill level, crew size, training requirements, technical data, and spares. The basic data systems for this technology are the Logistics Support Analysis Records (Military Standard 1388), and Maintenance Data Collection System (Air Force

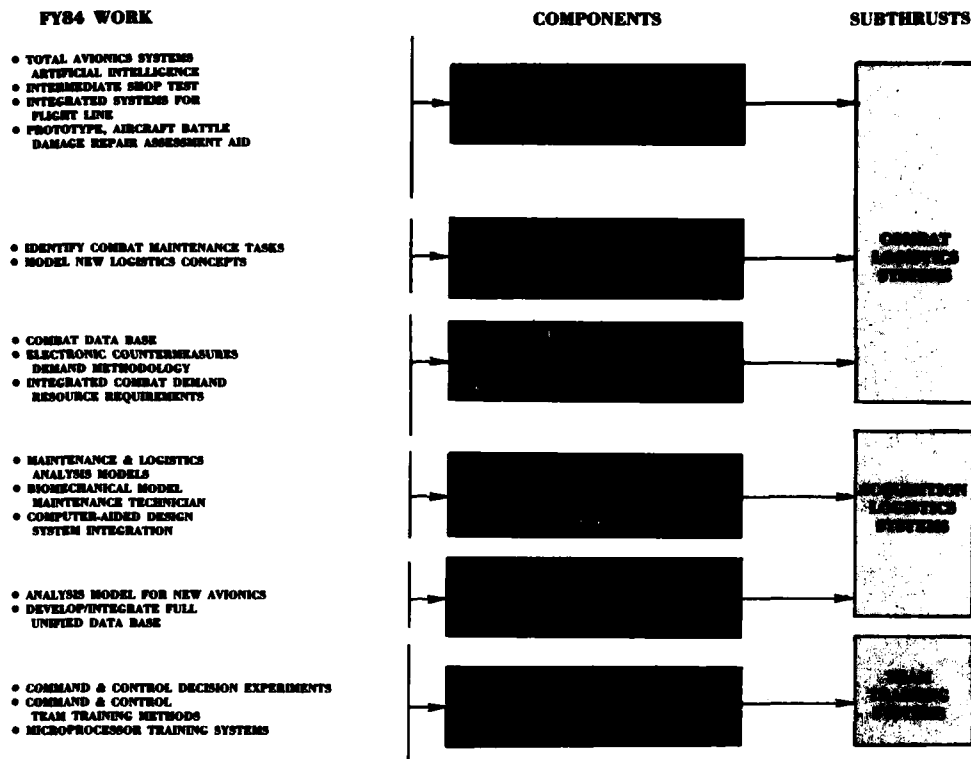
Regulation 66-1). The UDB is programmed for computer availability and a variety of data output modes are available to the user.

**Utilisation:** This technology and the resulting enhanced availability of logistics information will allow for a significantly increased consideration of logistics factors throughout the weapon systems design process. It will also form the basis for an advanced development program and will address Air Force Operational Test and Evaluation Center needs, computer-aided design interfaces and cybernetic techniques and applications. Prototype software has been developed and tested, and is being used in support of a major acquisition program. The full system will be tested and demonstrated on a representative weapon system acquisition program. After testing, it will be transitioned to the Air Force Logistics Center where it can be provided as a government-furnished program to contractors for use in weapon systems development. A significant decrease in logistics costs for modern weapon systems should result.

# ACQUISITION LOGISTICS SYSTEMS

## MAINTENANCE AND COMBAT SUPPORT THRUST

## R&D DIRECTIONS



## TECHNICAL ACHIEVEMENTS

**Title:** Analysis to Improve the Maintenance Environment

**AFHRL Contact:** Wendy B. Campbell  
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AUTOVON 785-2606

**Description:** This effort identified important factors that impact the performance of individuals, groups, and organizations performing aircraft and missile maintenance. The approach used was to look at the problem from the perspective of the people who actually perform, supervise, and manage maintenance operations in the field. This was done by conducting open-ended, one-on-one interviews with over 2000 aircraft and missile maintenance personnel on active duty or in the Air Force Reserves. Interviewees ranged

from senior management personnel down through the working level technician. All the major commands, including overseas forces, were represented, and interviewees were selected to represent different specialties, weapon systems, locations, skill levels, and maintenance environments. The project took a comprehensive approach to the maintenance area, with special attention to the role of human factors in effective, efficient maintenance. It provides the basis for an integrated research, development, and applications plan based on the factors that influence maintenance performance as perceived by those who are directly involved in maintenance work.

**Utilisation:** The results are being summarized in several volumes of AFHRL technical reports. Also, the data are being disseminated through briefings to the Air Force maintenance community. Work is

ongoing to develop a general strategy to address those problem areas that require further R&D. There are several ways in which various maintenance problems can be attacked. Each solution "path" has a cost, payoff, and feasibility value. A plan which addresses these considerations for the most important maintenance problem areas will be shared with all appropriate functional and R&D agencies. This can serve as a foundation for a unified research, development, and applications program for the improvement of Air Force maintenance.

**Benefits:** This effort has given Air Force management an overall picture of the problems in the maintenance community today, and has greatly enhanced awareness of them. By reviewing the total scope of maintenance problems it has allowed both managers and the research community to concentrate limited funds and manpower to finding solutions in those problem areas which are most serious and have the greatest chance of payoff. This view has encouraged changes that will improve the total maintenance system rather than improving one aspect of the system at the expense of others.

## ONGOING R&D

### **Title:** Combat Maintenance Capability Study

**AFHRL Contact:** Richard E. Weimer  
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AUTOVON 785-2606

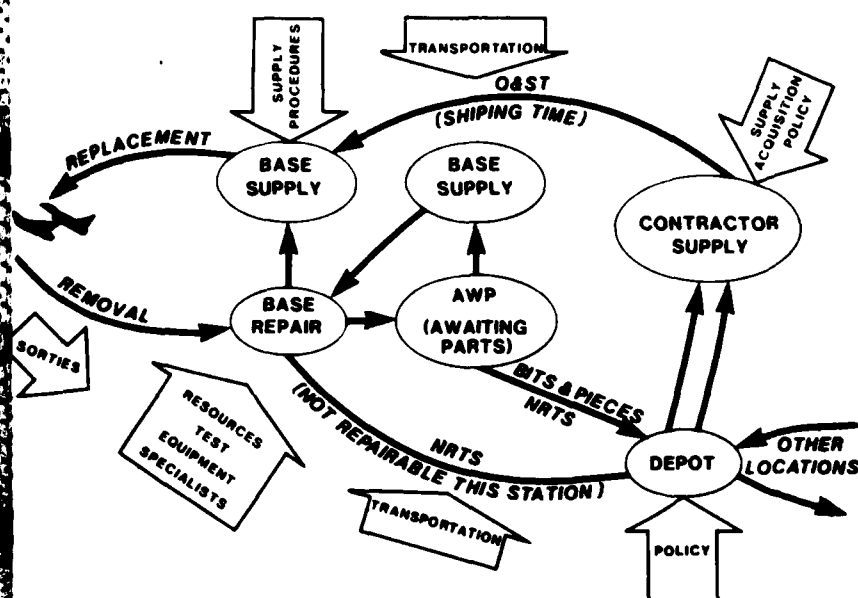
**Description:** No realistic means exist to fully measure the capability of a peacetime unit to successfully perform maintenance or logistics support roles in a combat environment. The difference between peacetime and wartime spares requirements are not fully known or understood. The objective of this effort is to examine systematically and critically the differences between peacetime maintenance processes with their material demands and those of combat for modern complex aircraft. This R&D will develop and demonstrate methods by which the Air Force can measure, quantify, and improve its combat maintenance capability.

Specifically, the project developed a wartime scenario at Hahn AFB, Germany, to parallel a wing operation in wartime. Modelling techniques were reviewed and selections made to optimally determine logistics composites, theater airbase resources and supply demands for wartime operations. An extensive data collection process included structured interviews and survey responses from maintenance workers both at CONUS and European airbases where the F-16 is operational. Vietnam combat-experienced maintenance personnel were interviewed as well. Surveys asked for expert opinions on task-time requirements both for peace and war time. Demands of accomplishing maintenance in chemical warfare environments were also investigated.

**Utilisation:** The results of this effort will be used by Air Force decision makers in determining policies, planning resources for combat, preparing units for combat, conducting operational exercises, enhancing combat logistics and maintenance effectiveness, and influencing the design of more supportable future weapon systems.



AFHRL Conducts R&D to Measure, Quantify,  
and Improve Air Force Combat Maintenance  
Capability



Electronic Countermeasures Logistics  
and Repair Flow Diagram

**Title: Wartime Demand Rates for Aircraft  
Electronic Countermeasure Equipment**

**AFHRL Contact:** Capt Keith A. Briem  
AFHRL/LRA  
Wright-Patterson AFB OH 45433  
Commercial (513) 476-2018  
AUTOVON 986-2018

**Description:** Because peacetime use of electronic countermeasure (ECM) equipment is limited, little historical data are available for use in the computation of wartime ECM requirements. Currently, there is no thorough method to aid the manpower and logistics specialists to plan support for wartime logistics requirements of aircraft ECM equipment. All available methods are based on peacetime operations and indicators, such as supply/demand rates, repair rates, and support factors. Subjective "best" estimates are, therefore, often used as input data, and this results in a low level of confidence in the requirements computation.

In an attempt to resolve these problems, several algorithms have been developed using strawman wartime demand rates. The end product will be computer software. Using this software, commands will be able to compute ECM parts wartime demand rates (given a single definition of war) that captures war, maintenance, and design induced demands to support the ECM system. Products derived from this software forecast parts required for the ECM War Readiness Spares Kit.

**Utilisation:** The methods developed will aid Air Force planning for wartime scenarios. With more accurate parts forecasting, the Not Mission Capable Supply rate for ECM parts will be reduced, resulting in improved operational effectiveness of ECM aircraft and a reduction on the attrition rate of ECM mission aircraft.

**Title: Automated Battle Damage Assessment Aid**

**AFHRL Contact:** Capt Stan Collins  
AFHRL/LRC  
Wright-Patterson AFB OH 45433  
Commercial (513) 255-2606  
AUTOVON 785-2606

**Description:** An automated aid will be developed to provide specialized technical data for use by maintenance personnel to assess aircraft battle damage. At present the battle damage assessor must rely on technical information that is scattered throughout the technical orders for the aircraft. The information is often incomplete and difficult to locate. The automated aid will provide the assessor with rapid access to information that is specifically designed to support the battle damage assessment task. It will provide information that is not presently available (such as estimated repair times) and will also include specially designed illustrations showing aircraft structures and the relative locations of system components. The data will be stored and displayed on a small (briefcase size or smaller), stand-alone, portable computer system.

The following items will be developed for the system:

- (a) a task analysis to specify information requirements,
- (b) an effective man-machine interface to ensure the system is easy to use and information can be retrieved rapidly,
- (c) hardware and software for the system,
- (d) techniques for preparing specialized battle damage assessment information,
- (e) battle damage assessment technical data for a section of a test-bed aircraft,
- (f) evaluation by having technicians use it to assess simulated battle damage to an aircraft, and
- (g) specifications for the assessment aid hardware and software, and for the technical data used with the system.

Off-the-shelf hardware and software will be used where possible.

**Utilisation:** Specifications will be developed for use in procuring the specialized technical data required for battle damage assessment. Results of the evaluation will be used to develop specifications for use in procuring the automated battle damage assessment aid for operational use.

# TEAM TRAINING SYSTEMS

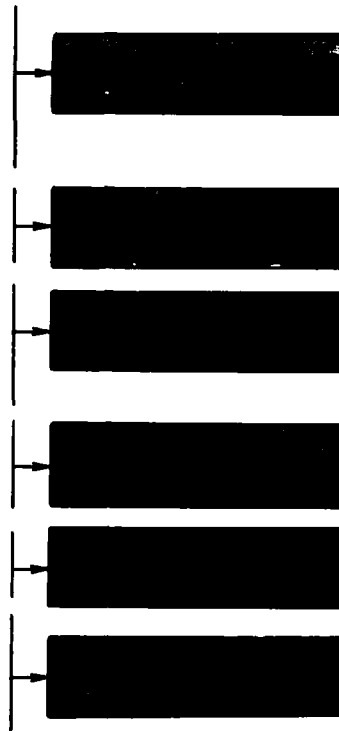
## MAINTENANCE AND COMBAT SUPPORT THRUST

## R&D DIRECTIONS

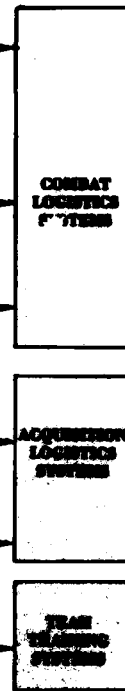
### FY84 WORK

- TOTAL AVIONICS SYSTEMS  
ARTIFICIAL INTELLIGENCE
- INTERMEDIATE SHOP TEST
- INTEGRATED SYSTEMS FOR  
FLIGHT LINE
- PROTOTYPE, AIRCRAFT BATTLE  
DAMAGE REPAIR ASSESSMENT AND
- IDENTIFY COMBAT MAINTENANCE TASKS
- MODEL NEW LOGISTICS CONCEPTS
- COMBAT DATA BASE
- ELECTRONIC COUNTERMEASURES  
DEMAND METHODOLOGY
- INTEGRATED COMBAT DEMAND  
RESOURCE REQUIREMENTS
- MAINTENANCE & LOGISTICS  
ANALYSIS MODELS
- MECHANICAL MODEL  
MAINTENANCE TECHNICIAN
- COMPUTER-AIDED DESIGN  
SYSTEM INTEGRATION
- ANALYSIS MODEL FOR NEW AVIONICS
- DEVELOP/INTEGRATE FULL  
UNIFIED DATA BASE
- COMMAND & CONTROL DECISION EXPERIMENTS
- COMMAND & CONTROL  
TEAM TRAINING METHODS
- MICROPROCESSOR TRAINING SYSTEMS

### COMPONENTS



### SUBTHRUSTS



## ONGOING R&D



Artist's Conception of  
Command and Control Interaction

**Title:** Combat Planning and Attack Capability

**AFHRL Contact:** Judith Krebs  
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Commercial (513) 255-5910  
AUTOVON 785-5910

**Description:** This work will develop a feasibility plan for establishing an Air Force focused, US-based, tactical command and control (C<sup>2</sup>) training and evaluation capability. To date, limited capabilities exist to train and evaluate commanders and battle staffs in their wartime duties. One overriding factor that contributes to this is that combat configured C<sup>2</sup> systems do not exist in peacetime. The personnel who staff these combat systems usually have different peacetime duties, which creates a disconnect as there are significant differences between modes of operations, numbers, constraints, stress levels, and criteria of success during war as opposed to peace.



## TEAM TRAINING SYSTEMS

This feasibility plan, known as the Combat Planning and Attack Capability (COMPAC), is based on the assumption that the proposed training capability will build on the existing Blue Flag facility at Hurlburt AFB, FL, where training for US tactical C<sup>2</sup> teams is presently conducted. Data collection has consisted of in-depth reviews of existing documentation on Air Force regulations as well as intensive site visits. The intent of this project is to document what currently exists in the tactical C<sup>2</sup> arena in terms of training, professional military education, personnel policy, automation, and management issues. Based on these data, the final plan will contain sufficient detail to serve as a guide for systematically achieving, through modular implementation, a total capability.

**Utilisation:** This product will determine the technical requirements for establishing a high fidelity tactical C<sup>2</sup> training and evaluation capability. This capability will serve three primary functions: (a) to train and evaluate personnel assigned and/or scheduled to augment tactical C<sup>2</sup> systems in their combat duties, (b) as a capability to evaluate the operational impact of new C<sup>2</sup> system components on overall system operations, and (c) to assess the efficiency and effectiveness of existing and new procedures and strategies. The knowledge gained during the development of the COMPAC feasibility plan and the resulting documentation will feed into other areas of R&D presently underway within AFHRL. Specifically, the resulting documentation will highlight existing training and performance assessment needs of tactical C<sup>2</sup>.



Computerized Simulated Tactical Decision-Making

**Title:** Tactical Battle Management Research Capability

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AUTOVON 785-5910

**Description:** In general, the aim of this R&D program is to measure and assess the decision-making

performance of command-level personnel and, if the results warrant, to develop and test training programs that could potentially improve this type of performance. The approach being taken in this R&D area includes development of an innovative computer-based, in-house simulation of specific tactical command and control (C<sup>2</sup>) decision-making situations. A series of these in-house studies were conducted on issues dealing with human information processing, information transfer, and decision making. To date, progress in this effort has developed several separate tactical scenarios/problems, and these have been entered in the Tactical Battle Management Software Simulator.

**Utilisation:** The unique aspects of this capability include the ability to automatically collect data on the performance of individuals and/or teams, while preserving the essential complex nature of the decision-making situation. This simulation can also be used to investigate methods of training tactical decision makers or teams and can be configured to test new methods and procedures. One specific example will be to investigate the best way of training personnel on the most effective methods to use when preparing air tasking orders for offensive counterair missions. A future development effort will likely be directed towards development of training methods for electronic warfare.

**Title: Improved Training for Command and Control Battle Staffs**

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**Description:** The purpose of this project is to develop, test, demonstrate, and evaluate technology for the training and evaluation of personnel who operate tactical command and control (C<sup>2</sup>) systems. In order to achieve this, attention is being directed to the importance of the individuals and teams that operate these systems and the interaction between human performance, hardware, and operational procedures. Emphasis will be placed on the actual definition of wartime skills and procedures. This project is exploring the different methods for analyzing peacetime/wartime job performance and training requirements, determining training and evaluation programs, and specifying performance tests. This exploratory effort should also identify many research issues for further study, particularly in training and evaluation technology.

**Utilisation:** The development of a new analysis technology for accurately identifying the actual wartime training requirements, will make it easier to select personnel for critical positions in the Tactical Air Control Center. The set of new analysis techniques will extend and refine a number of existing methods (e.g., task analysis, systems analysis). These new methods are extremely critical and will be used to develop accurate training programs that cover the

specific wartime training requirements. The overall use derived from this work will provide improved methods for individual team training and evaluation methods to assess the combat readiness of tactical teams. The Tactical Air Forces will benefit from this project by having combat-ready personnel assigned to the main tactical C<sup>2</sup> systems. In addition, with the proper training, the users of the C<sup>2</sup> centers will have the ability to operate smoothly and efficiently in the face of enemy action and a rapidly changing tactical environment.



AFHRL is Developing Technology  
to Train and Evaluate C<sup>2</sup> Operators

***"I don't think you can overstate the importance of effective training today. It has a direct relationship to readiness and combat capability--and the success of our deterrent posture."***

***". . . man has become more central in our hardware decisions. The role of man as a key element within weapon systems has broken through the hardware bias that has plagued weapon system R&D for years."***

***"In your business, the final product is not hardware. Your final product is a fully trained man or woman."***

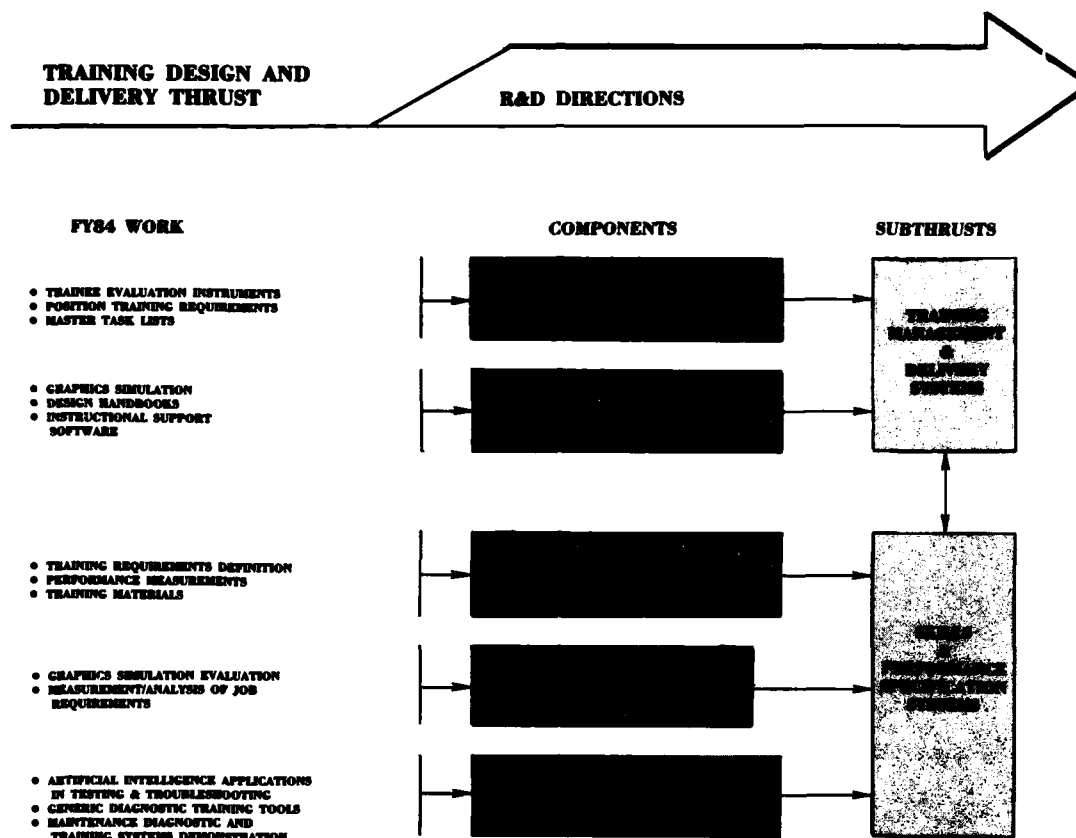
***"The bottom line in training systems and training equipment is how quickly and accurately can one or the other training system--or piece of equipment--produce a trained person. And at what cost. Those are the criteria that determine the affordability and usefulness of particular training systems."***

***Keynote Address by General Marsh to  
Training Equipment Conference  
Washington, D.C., 14 November 1983***



**TRAINING**  
**DESIGN &**  
**DELIVERY**

# TRAINING DESIGN AND DELIVERY THRUST



## TRAINING MANAGEMENT AND DELIVERY SYSTEMS

## TECHNICAL ACHIEVEMENTS

**Title:** Improved Non-Destructive Inspection Technician Capabilities

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**Description:** Recent wide-scale performance testing has resulted in challenges to the ability of Air Force non-destructive inspection (NDI) technicians to find flaws in aircraft structures with the precision and reliability demanded by aircraft design engineers. As a result, the Air Force has identified two urgent needs: first an analysis of relationships between NDI technician performance and personnel data, designed to identify particular features of good inspectors, and second a capability for NDI technicians to practice NDIs in Air Force field laboratories. These two needs represent the two objectives of this R&D effort. In the first objective, Armed Services Vocational Aptitude Battery scores and questionnaire-generated personnel data were compared to actual NDI performance test scores. In general, there were no specific features found among good inspectors that could lead to

improved selection, training, or retention of NDI technicians.

In the second objective, specifications were developed for a stand-alone trainer that would allow inspectors to practice the ultrasonic NDI technique on the job. The specifications were divided into two phases. The first phase specified the functional requirements--the performance characteristics of the trainer and the behaviors that the trainer was to develop and sustain. The second phase specified the engineering/physical characteristics the trainer must have in order to accommodate those functional requirements identified in the first phase.

**Utilisation:** The products of this effort are a complete set of detailed specifications, including costs, for an ultrasonic NDI trainer. This will enable acquisition agencies to acquire a prototype of the trainer.

**Benefits:** Potential payoff to both military and civilian non-destructive testing communities is extremely high. With regard to Air Force maintenance in particular, the added capability offered by the specified trainer will effect safer and less costly ground and flight operations.



Trainers Used to Teach Simulator Maintenance

**Title:** Flight Simulator Troubleshooting Trainer

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**Description:** Flight simulators have increasingly been employed as one cost-effective solution for maintaining a variety of complex aircrew teamwork skills. However, the personnel directly responsible for maintaining these complicated, computer-based simulators have little time to correct the intricate malfunctions occurring within the simulators. There is also limited time to train novice simulator technicians systematically in efficient methods of troubleshooting. In addition, a growing body of evidence indicates the limitations/constraints of actual flight simulators for training technicians in logical problem-solving skills.

To reduce the gap between maintenance training requirements for job competencies and the real-world operational requirements/limitations of the actual equipment, a prototype flight simulator troubleshooting trainer was developed.

The trainer provides technicians with a substantially improved capability for hands-on practice in troubleshooting many of the more frequent malfunctions

of the actual flight simulator. The trainer (a) models the major subsystem components of a representative flight simulator, (b) emphasizes the functional and logic flow relationships of the components, and (c) provides a wide range of simulated malfunctions for technician troubleshooting practice.

To further enhance the overall effectiveness of the trainer, additional instructional features, such as automated performance measurement and automated student feedback, are incorporated in the device. The device was utilized by the 380th Aircraft Maintenance Squadron (AMS) at Plattsburgh AFB, NY. The lessons (malfunctions) have been reviewed by that technical staff and suggested revisions accomplished. A formal summative evaluation of the troubleshooting trainer's impact on subsequent job performance and relative on-the-job training costs is underway.

**Utilisation:** Novice technicians assigned to the 380th AMS have employed the device since May 1983. This trainer was used to train maintenance technicians at the duty station on troubleshooting the F-111 flight simulator, a relatively complex and mature flight simulator.

Preliminary results indicate technicians are favorably disposed toward a training device that allows them to apply their newly acquired knowledge and skills on malfunction problems with no fear for personal safety nor of damage to expensive equipment. Given a reliable, adjunct, interactive training device for troubleshooting skills training, novices can be expected to solve operational malfunctions confidently in less time than the costly trial-and-error approaches characteristic of uncertainty and inexperience.

If the approach embodied in the troubleshooting trainer is validated in this initial application, similar trainers could be developed for the full range of present and future flight simulators. The hardware configuration and controlling software are suitable for troubleshooting training in general and are not uniquely associated with this particular application. New malfunctions and the associated microfiche images would have to be developed for each system. The results of this effort may eventually be generalized to other complex electronic systems that are similar to flight simulators in design and architecture and offer limited opportunity for maintenance training.

## TRAINING MANAGEMENT AND DELIVERY SYSTEMS



Computer Programmer Developing  
Standardized Instructional Software

**Title:** Computer-Based Instructional  
Technology Transfer

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**Description:** The value of new technology resulting from R&D is its usefulness to the operational/user communities. The ultimate test of a new technology is its contribution toward developing, supporting, and maintaining a superior combat ready force. There are both formal and informal mechanisms within the Air Force for transitioning new technologies from the R&D community to the operational/user communities. The following are some specific examples of technology transfer being pursued by AFHRL/Lowry.

(1) Tactical Air Command (TAC) - A successful demonstration of a forward-looking resource scheduling system (FLRS) was conducted by TAC using terminals connected to the AFHRL computer. The TAC Director of Operations has approved proceeding with the FLRS effort.

(2) National Security Agency (NSA) - NSA currently is using the computer-based instructional (CBI) system at AFHRL. Four terminals at NSA/Washington D.C., are connected to the AFHRL computer. This will be a 12- to 18-month effort to allow NSA to develop, demonstrate, and evaluate advanced CBI technologies.

(3) Air Force Manpower and Personnel Center (AFMPC) - AFMPC started using the AFHRL CBI system with four to six terminals at Randolph AFB connected to the AFHRL computer. Initially, one terminal was on-line and was used for demonstrations and course author training. The AFMPC effort will also be a 12- to 18-month project that is expected to result in standardized software on an AFMPC VAX 11/780 computer.

(4) Tri-Service Engineering Development - A tri-Service project is aimed at capitalizing on previous R&D technologies to develop a tri-Service CBI training device. The approach is to utilize the Navy- developed Electronic Equipment Maintenance Trainer in an enhanced form and the standardized instructional support software being developed and managed by AFHRL.

(5) Space Command - The Air Training Command Technical Training Center at Lowry AFB provides training for operator and maintenance personnel assigned to space systems. Personnel in Space Command Headquarters at Colorado Springs and the Space Command units at Sunnyvale and Vandenberg AFB, CA are interested in exploring innovations in this training. The opportunity to apply advanced CBI technology to this training would permit AFHRL to impact space training significantly.

(6) Training in Ada - The Department of Defense (DoD) Standard Computer Language - The DoD Ada Project Office has been in contact with AFHRL to analyze the type of training needed to establish a capability to train thousands of DoD programmers worldwide in the use of Ada. AFHRL is in a position to take the lead in this area and to make a major cost-effective contribution to DoD.

(7) B-1B Aircrew Training Program - After evaluating available computer-based training systems, the 4235th Specialty Training Squadron at Carswell AFB, TX has determined that the technology currently available within the computer-based training system at AFHRL is applicable to their developing training mission. Terminals connected to the AFHRL computer are currently installed at Carswell AFB for development of aircrew courseware methodologies. The 4235th Specialty Training Squadron is in the process of acquiring their own capability to host the AFHRL computer-based training system in support of actual B-1B aircrew training courseware development and presentation.

(8) The ongoing standardized software development at AFHRL is directed toward making all of these activities operationally feasible. This project is developing a mini/microcomputer version of the Advanced Instructional System written in a standard language. Once completed, standardized software will be available to all DoD users as a transportable, modular, highly flexible computer-based training system.

**Utilization:** AFHRL has agreements with several operational/user organizations to allow them access to the AFHRL CBI system. This access will permit these organizations to explore advanced training technology that has resulted from AFHRL R&D activities over recent years. It is anticipated that a carefully planned and systematic transition of advanced CBI technology to the operational/user community will result in improved training and ultimately, in improved performance.

**Title:** Interactive Computer Graphics Simulation for Intermediate Level Maintenance Training

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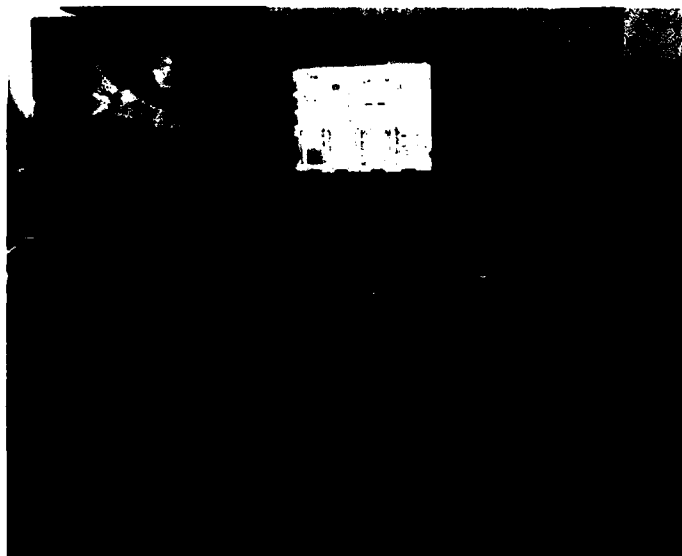
**Description:** Readiness of increasingly complex aerospace systems depends, in large part, on the knowledge and skills of job competent maintenance technicians. Efficiently producing sufficient numbers of skilled troubleshooters requires an adaptive training capability that provides individual students with the opportunities (a) to acquire difficult, abstract conceptual relationships, and (b) to practice troubleshooting skills on samples of malfunction problems representative of those to be encountered subsequently on the job. The potential of interactive graphics simulation to facilitate both learning and troubleshooting-skills practice provides a cost-effective alternative to costly, unreliable, and labor-intensive actual equipment training.

The objectives of this R&D effort are to design, develop, and demonstrate the related cost effectiveness of the graphics simulator versus the actual equipment trainer, and to determine the transfer-of-training effectiveness of various simulation instructional strategies, given job tasks of varying difficulty.

The prototype test bed has been built on the existing R&D capabilities of the computer-based instructional

system at Lowry AFB. These capabilities include data collection and analysis, computer-assisted instruction, and computer graphics generation. The basic hardware configuration consists of a high resolution color graphics terminal and a video disk unit. The video disk unit is capable of representing a variety of adjunct media (i.e., microfiche, video tape, slides, film, etc.).

**Utilization:** This research will produce a graphics simulation of test-station tasks, specifications for a low-cost device targeted for the training environment, and a research test bed for the resolution of issues associated with maintenance-training graphics simulations. Furthermore, the test bed can be considered as a prototype system for establishing functional specifications for a variety of part-task training simulations. Such a system could be used by the Systems Program Office in determining least-cost simulations. This effort is extremely important in determining the correct match for a training task and its graphics-level simulation. The results of this effort can be used in developing graphics-level simulations for new weapons systems and equipment, as well as for current systems. This effort will demonstrate and evaluate a simulator with low physical fidelity, but with high potential for maintenance training, including troubleshooting. Devices and software will serve as a test bed for future investigations.



Graphics Simulation Enhances Maintenance Training



## TRAINING MANAGEMENT AND DELIVERY SYSTEMS

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**Title:** Handbooks and Model Specifications for the Design and Development of Maintenance Simulators

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**Description:** Simulation devices/methods have been used formally for more than 50 years as tools to aid decisions in selection, training, and performance assessment of aircrew and maintenance personnel. Yet, little empirical evidence is available to guide decision makers in the cost-effective design, development, and implementation of simulators. In particular, properly designed training simulators have the potential to produce job-competent performers for a variety of occupations and tasks ranging from procedural operations to complex problem-solving. A growing body of evidence suggests that for certain training tasks and learners, simulators are as effective as actual equipment trainers, but simulator life-cycle costs conservatively comprise only one-third to one-half of the actual equipment costs.

Whether future maintenance training simulations will be both cost and training effective depends largely on designer knowledge of the interrelationships among the following factors: (a) characteristics of the learners, e.g., aptitude and achievement motivation levels, (b) characteristics of the job/tasks to be mastered, e.g., difficulty level, (c) characteristics of the organizational environment in which performers of varying capability confront tasks of varying complexity/environmental stress, and (d) characteristics of alternative training devices/methods, e.g., cost-effectiveness payoffs of features for adapting, monitoring and challenging student performance. Given factual data on the interrelationships among the four preceding factors, training system designers can tailor simulator designs to optimize trainer cost effectiveness. R&D is therefore needed to provide designers with those facts.

The objectives of this effort are to produce (a) a set of introductory instructional systems development (ISD) guides, (b) model simulation trainer specification guides for maintenance trainers and flight simulator trainers, (c) logistical support guides, and (d) a synthesis of cost-effectiveness information derived from simulator applications in both government and industry. The latter will be incorporated into a set of simulator design decision aids to assist Systems

Program Office (SPO) personnel tasked with the effective and efficient design of simulators versus actual equipment trainers. Primary handbooks have been developed.

**Utilisation:** The resultant guides should be useful to ISD teams during the development of training specifications for maintenance simulators. SPO personnel will use the documents in the translation of training requirements into equipment specifications in such a way that effective training devices will result. Collectively, these documents facilitate the determination of whether a trainer is needed. If a trainer is required, the guides facilitate (a) the precise specification of training requirements, (b) the equipment required to support that training, (c) the logistical support anticipated over the life cycle of the training, and (d) the impact of design decisions on life-cycle costs.

Initial users are the Test and Evaluation Squadron of the Air Training Command at Edwards AFB, CA and the SPO at Wright-Patterson AFB, OH. The publications are also being used by other Air Force agencies, as well as by the Army and the Navy.

**Title:** Transportable Instructional Applications Delivery System

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**Description:** The Transportable Instructional Applications Delivery System (TRIADS) program is a joint-Services effort to develop a family of hardware and software to support computer-based instruction (CBI) in a variety of military training and educational applications. It is also intended that the program will serve as a foundation for the creation of operational military CBI centers.

The CBI centers could assist interested DoD agencies by (a) demonstrating CBI system capabilities, (b) identifying steps needed to obtain funding, (c) performing or assisting in system definition studies, and (d) assisting in system acquisition, development, implementation, and maintenance. The centers would maintain a software library, ensure configuration management, and perform software acceptance tests of new additions from R&D programs or from other military agencies.

The TRIADS program has several critical elements. First, a library of CBI programs sufficiently flexible to support development, delivery, and management requirements of most military training environments must be assembled from existing R&D products. At the same time, it is necessary to conduct demonstrations to promote the program and provide formative evaluation and to develop functional specifications for hardware systems capable of executing the TRIADS software. Finally, it is necessary to plan for the institutionalization of joint-Services CBI programs.

TRIADS is sponsored by the Office of the Under Secretary of Defense for Research and Engineering, and is being performed by a working group composed of representatives from AFHRL, the Army Research Institute for the Behavioral and Social Sciences, the Navy Personnel Research and Development Center, the Naval Training Equipment Center, and the Army Program Manager for Training Devices.

**Utilization:** Because it is modularized and expandable, TRIADS software and hardware will be adaptable to most military training situations. TRIADS will serve as a low-cost simulation device for maintenance training tasks requiring two-dimensional and/or three-dimensional simulations. TRIADS can be configured to deliver computer-assisted instruction to a number of simultaneous users, and will perform many instructional management functions. TRIADS has relevance to a variety of military training operations. It will embody the demonstrated capabilities of military R&D efforts in the areas of maintenance simulation and computer-based training. These capabilities will allow for increased training effectiveness, enhanced instructional management, and the possibility for effective job-aiding applications. TRIADS will reduce the proliferation of single-purpose training systems and the associated maintenance, configuration management, and support problems.

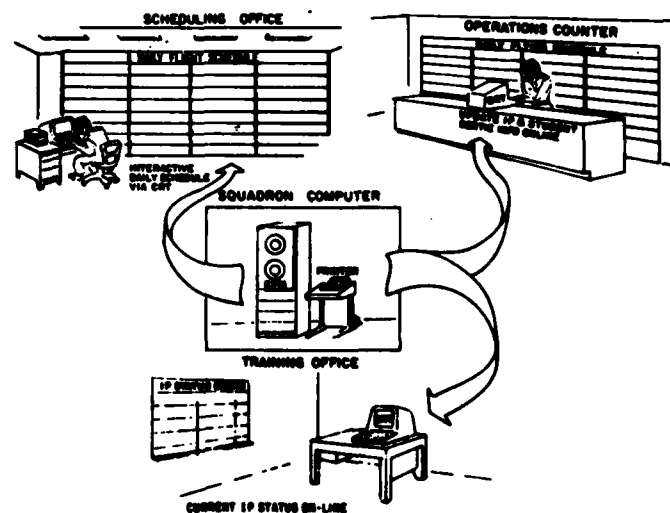
**Title:** Forward-Looking Resource Scheduling System

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**Description:** Because of the increasing complexity of the modern day flight-training syllabus, an inordinate

amount of time is being spent in developing daily flight schedules. The objective of the first phase of this project was to reduce daily flight-scheduling man-hours by 50% by developing and demonstrating the feasibility of computer-assisted daily flight scheduling.

The approach was to build the scheduling system around the existing database and editor approach of the Air Force Advanced Instructional System (AIS). Utilizing student, instructor, course syllabus, and schedule databases, the system assisted the scheduler by producing a basic schedule that was syllabus specific and conflict free. The scheduler then fine-tuned the schedule through an on-line cathode ray tube. Likewise, to maintain currency, student and instructor databases were updated at the end of each sortie. Responding to additional requirements identified during this phase, AFHRL has proposed to the Tactical Air Command (TAC) that a joint effort be initiated to enhance forward-looking resource scheduling (FLRS) through the application of existing AIS technology. This would provide historical data collection and analysis, requirements forecasting, reports generation, and academic assistance capabilities.



Computers Expedite Resource Scheduling

**Utilization:** The effort resulted in a demonstrable daily flight-scheduling capability. The feasibility demonstration was conducted during February 1982 in one squadron of the 479th Tactical Training Wing of TAC at Holloman AFB, NM. In the second phase, which is being proposed as a joint TAC-AFHRL effort, the additional capabilities will be integrated into the system, and the technology will be transitioned to TAC for implementation within a full wing at Holloman AFB. TAC has written a Request for Personnel Research. TAC has identified three major categories of benefits that would result from full implementation of an FLRS system: (a) direct cost savings--primarily operation and maintenance costs for students on temporary duty, (b) time savings--reducing scheduling man-hours by two-thirds, allowing people to do what they do best, and (c) quality control--eliminating syllabus deviations, improving student training continuity, and reducing unprogrammed direct support missions.

**Title:** Instructional Support Software System

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**Description:** AFHRL has developed a computer-based instructional (CBI) system employing both computer-aided instruction and computer-managed instruction techniques. It is a large-scale system requiring a specially modified CYBER computer for operation. The system was originally designed to support a very large number of students in a variety of training courses and, simultaneously, to support R&D efforts involving technical training issues. The R&D has now progressed to the point where transfer of this technology to the operational community (i.e., major commands), as well as to other DoD agencies, is desired. This technology must be in an affordable, maintainable, and current state-of-the-art configuration. This effort will provide that product and at the same time preserve the significant investment that has been made in developing improved approaches to individual training.

**Utilisation:** The principal purpose of this effort is to develop and demonstrate that one or more of the functional components of this CBI system can reside and execute on small, affordable mini/microcomputers. This will be accomplished by

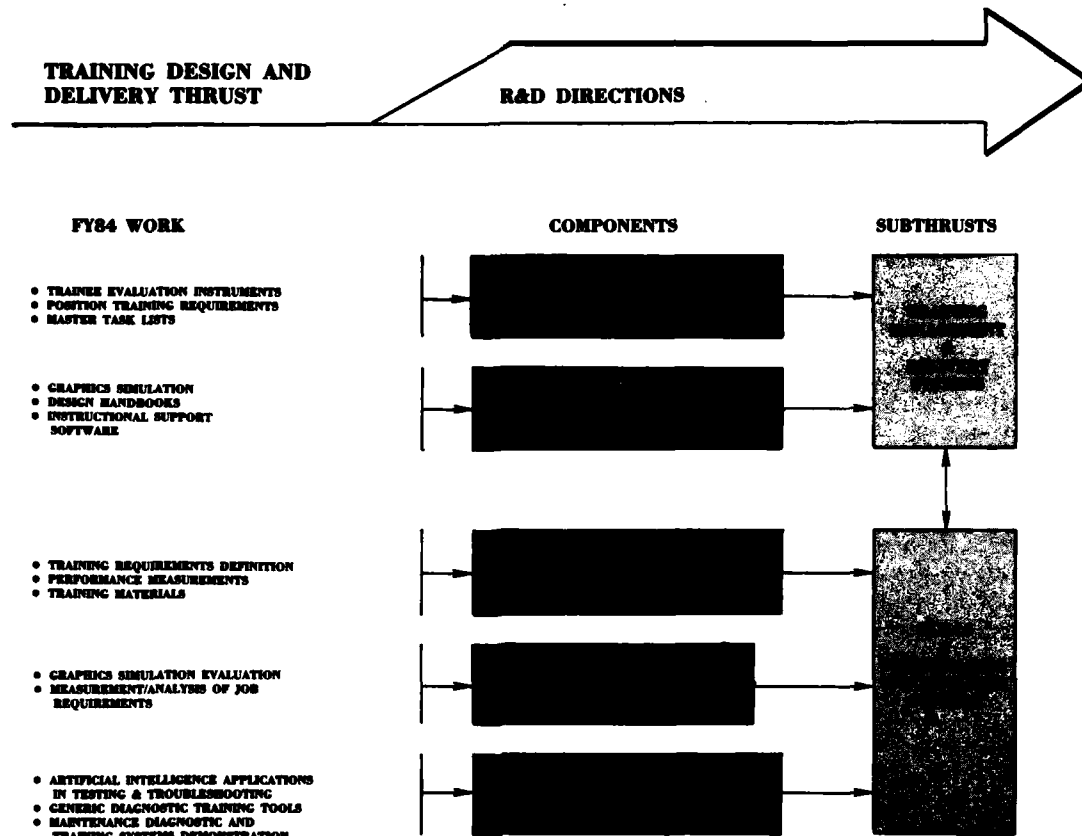
converting the CBI software to a standard high-order language that will be widely available and supportable on a large number of machines. The DoD standard programming language, Ada, will be used.

A mature CBI system with over 10 years of development will be available to a wide range of users. Because of the modular configuration of the instructional support software (ISS) system, users will be able to select only those functional capabilities desired. Very small to very large configurations will be possible. Because the system is fully integrated, users can add additional functional capabilities at a later date without having to redo all their previous work. The system will be in Ada; therefore, transportability over a wide range of vendor hardware will be possible. The use of Ada will mean that one common software package will exist and that it can be maintained for all locations from one control site. The final software product is to be put in the public domain. Commercial, private, and public organizations can use the ISS as the basis for their own training systems.



Standardized CBI Software  
Facilitates Technology Transition

# SKILLS AND PERFORMANCE SPECIFICATION SYSTEMS



## TECHNICAL ACHIEVEMENTS

**Title:** Personnel Requirements for Non-Conventional Instruction

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**Description:** This effort investigated the roles and behaviors of instructors in non-conventional instruction (NCI). Questionnaires and interview forms were constructed, and 99 NCI personnel in 10 courses at four Air Training Command centers were queried. The theoretical role model, against which data in this study were analyzed, establishes the ideal role order as counselor, modeler, evaluator, diagnostician, remediator, implementor, and planner. Considerable variability was found in the order of, and in the time spent in, the behaviors required of instructors across NCI courses. The principal findings from analysis of the data are that (a) NCI instructors spend more time than is considered ideal in administrative, clerical, and instructional management roles and less time than ideal in learning facilitator and tutorial roles, (b) percentages

of time spent in theoretically ideal roles is influenced by the instructor's years of experience and attitude about both the job and prior job training, and (c) number/types of instructor-perceived problems are influenced by those same factors. Approximately 20% of instructor time is spent in roles not included in the theoretical role model, e.g., author, equipment maintainer, supervisor, clerical, and administrative. These duties might be effectively assumed by non-instructor personnel.

**Utilization:** Principal products of this study are the NCI role model, its implications for personnel requirements, and recommendations for training and utilizing instructors in NCI.

**Benefits:** Potential payoff to Air Force technical training lies in the improved effectiveness of the training and utilization of instructors in non-conventional training environments. By emphasizing the use of instructors in the designated ideal roles and assigning remaining functions to non-instructor personnel, training for instructors can be more specific in preparing them to function effectively on the job.

**Title:** Effective Application of Computer-Assisted Instruction Within Different Instructional Settings

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**Description:** The degree to which computer-assisted instruction (CAI) is effective varies substantially from one situation to another. This effort is investigating the factors that create those variations in effectiveness, with the goal of establishing predictors of effectiveness of CAI applications. Once all such factors have been so ordered, they will be transformed to a decision matrix. This will ensure that all relevant factors can be weighed in CAI implementation decisions. A handbook has been developed and is in the process of being evaluated at two Air Training Command bases.

**Utilization:** The ultimate product of this effort will be a course manager's handbook that will prescribe the appropriate level of CAI application and will identify the required resources. This handbook is expected to be used for training development decisions in all military technical training programs. CAI is an effective medium of instruction if appropriately applied. The handbook will provide guidance that will ensure cost-effective utilization.

**Title:** Critical Factors Associated with Self-Paced Instruction Implementation

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**Description:** This effort was undertaken to systematically study factors that influence self-paced instructional designs and, to identify those factors that are decisive to the successful implementation of a self-paced course. The approach was to identify candidate factors from an analysis of existing military and civilian reports, and to employ interview and case study techniques to determine factors for examples of successful and unsuccessful implementations within the Air Training Command. In general, the major finding of this effort was that successful self-paced courses had characteristics that could produce cost

benefits. It was found, also, that flexible, creative, and knowledgeable managers, as well as high instructor dedication and motivation, are extremely important if implementation is to be successful.

**Utilisation:** The results of this study will aid instructional system designers and personnel involved in the design and implementation of new instructional technologies. By attending to the factors identified in this study, the incidence of unsuccessful implementations of self-paced instructional designs could be reduced.

**Title:** Artificial Intelligence Applications in Training, Job Aiding, and Performance Assessment

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AUTOVON 926-2482

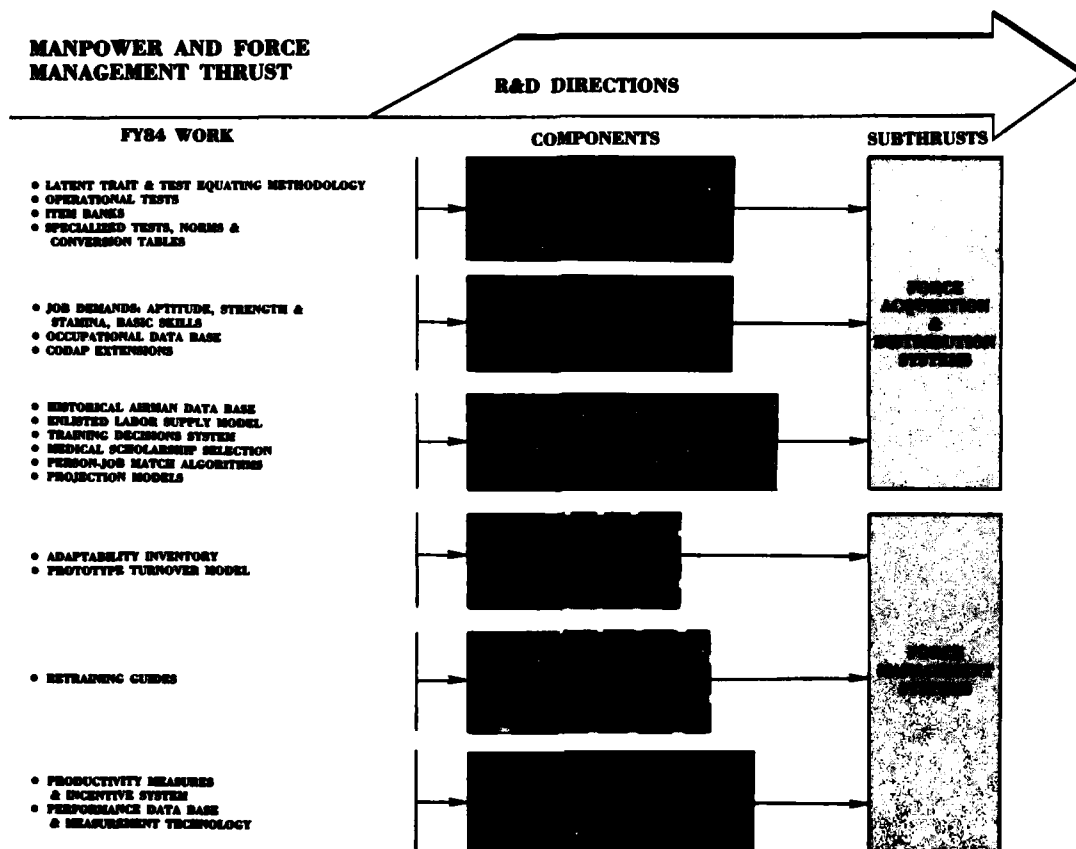
**Description:** The Air Force has been interested and involved in artificial intelligence (AI) research for some time, but practical applications in this field have been limited because of expense and a lack of development tools. AI is the study and application of what is known about intelligent behavior to the development of machine systems, especially computer systems. This effort will conceptualize a program plan for the development, validation, and implementation of AI applications. The plan will help solve Air Force problems in the areas of technical training, performance assessment, and job performance aids. Also, this effort is structured to provide hands-on experience with existing expert systems in order to allow AFHRL personnel to familiarize themselves with the new technology. Several systems will be acquired for evaluation on existing AFHRL/Lowry hardware systems.

**Utilisation:** This initial effort will develop a program plan for AI applications. It will also develop a functional specification for a test bed system where R&D issues involved with integrated job-aiding and training systems may be explored. A comprehensive, unified, and coordinated plan can enhance R&D program responsiveness by reducing duplication of effort, promoting sharing of resources and products, and encouraging program support from the user community.



# MANPOWER & FORCE MANAGEMENT

# MANPOWER AND FORCE MANAGEMENT THRUST



## FORCE ACQUISITION AND DISTRIBUTION SYSTEM

## TECHNICAL ACHIEVEMENTS

**Title:** Study of Alternative Weighting Systems for the Weighted Airman Promotion System

**AFHRL Contact:** C. Deene Gott  
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AUTOVON 240-2912

**Description:** In response to a request from the Directorate of Personnel Plans at Headquarters USAF (HQ USAF/MPX), a study was carried out to develop alternative weighting systems for the Airman Performance Report (APR) factor in the operational Weighted Airman Promotion System (WAPS) formula. The objective was to remedy or minimize the problem of promotion selection to grades E-5 through E-7 of airmen with recent, low APRs, i.e., APRs which are 7 or less. This problem of WAPS selections of "poor performers", using the present WAPS formula,

received considerable attention across the Air Force and is a major concern of MPX. Basic weighting strategies which were investigated included the following: (a) weighted average of APR ratings, with most recent ratings being most heavily weighted, (b) splitting of the APR factor, with the single recent APR being emphasized over other APRs, (c) adjustments to the APR factor, with penalties assessed for trends that show continued unsatisfactory performance, and (d) differential weighting of APR ratings, with higher APR ratings being weighted more heavily than lower ratings. Variations and combinations of these strategies resulted in the development and evaluation of over 30 alternative weighting systems. The most promising systems were selected and applied to actual airman records in three complete WAPS promotion cycles for a total of 158,715 cases. The objective was to assess each system's impact on promotion outcomes in terms of the following criteria: (a) effectiveness in eliminating promotion selectees with ratings of 7 or

less on their most recent APR, (b) percent overlap among promotion selectees identified by an alternative system and by WAPS, (c) promotion selection rates for sex/minority subgroups, and (d) promotion selectee quality reflected by average scores on the six WAPS promotion factors (Specialty Knowledge Test, Promotion Fitness Examination, time-in-grade, time-in-service, decorations, and APR) by the mutually exclusive subsets of selectees identified by an alternative system and by WAPS. Results were briefed to the staff offices of HQ USAF/MPX and the Air Force Manpower and Personnel Center.

**Utilisation:** Information developed in this study will be used by HQ USAF/MPX to remedy the problem of WAPS promotion selection of poor performers. Also, it will bring the WAPS formula into better alignment with the current Air Force management position regarding job performance and promotion selection.

**Benefits:** The results of this study can be used by policymakers to make improvements to WAPS, whereby the most deserving airmen are promoted to grades E-5 through E-7. Equity in promotion selection and emphasis on recent performance are viewed as important ingredients in a promotion system that impacts upon the all-important mid-level grades

of the enlisted corps. Retention rates, quality of job performance, and corps morale depend on a system that is both visible and equitable.

## **Title: Extensions of Hierarchical Grouping Using the HIER-GRP Program**

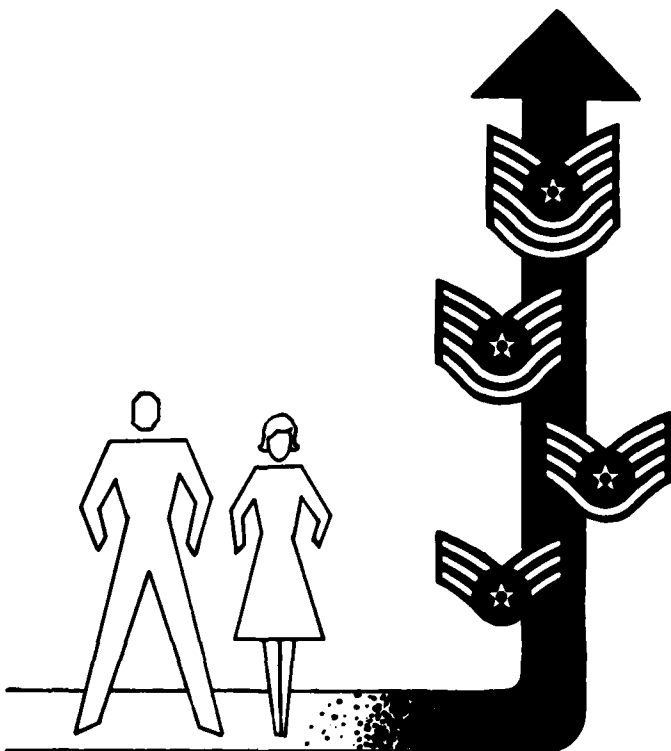
**AFHRL Contact:** Joe Ward  
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**Description:** A hierarchical grouping computer program (HIER-GRP) was developed to group a set of regression equations in a stepwise manner that minimizes the overall loss of predictive efficiency at each step. This program has been used extensively for grouping regression equations in which the number of cases is the same for each equation and the predictor correlation matrix is the same for all equations being considered for grouping. Now HIER-GRP can be used for grouping analyses in more general situations than the special case for which the program was originally designed.

**Utilisation:** Frequently it is desired to cluster prediction systems in which each equation is derived from a different set of predictor data. This situation occurs, for example, when final technical school grades (or attrition, reenlistment, etc.) are predicted from personnel data prior to entering the Air Force.

In the practical problem of classifying personnel into different career areas, it is frequently desirable to reduce the number of job types to a small number. In this situation it is desired to classify persons into jobs (Person-Job Match) so that the overall measure of performance (the objective function) is maximized. The clustering procedure should group jobs together such that persons considered for a classification within a job cluster can be interchanged among all jobs in the cluster with very small effect on the overall measure of classification effectiveness. In this situation jobs should be clustered for which the differences between predicted job success among any pair of jobs within the cluster are nearly constant for all people. This is described as "little interaction between people and jobs within the cluster."

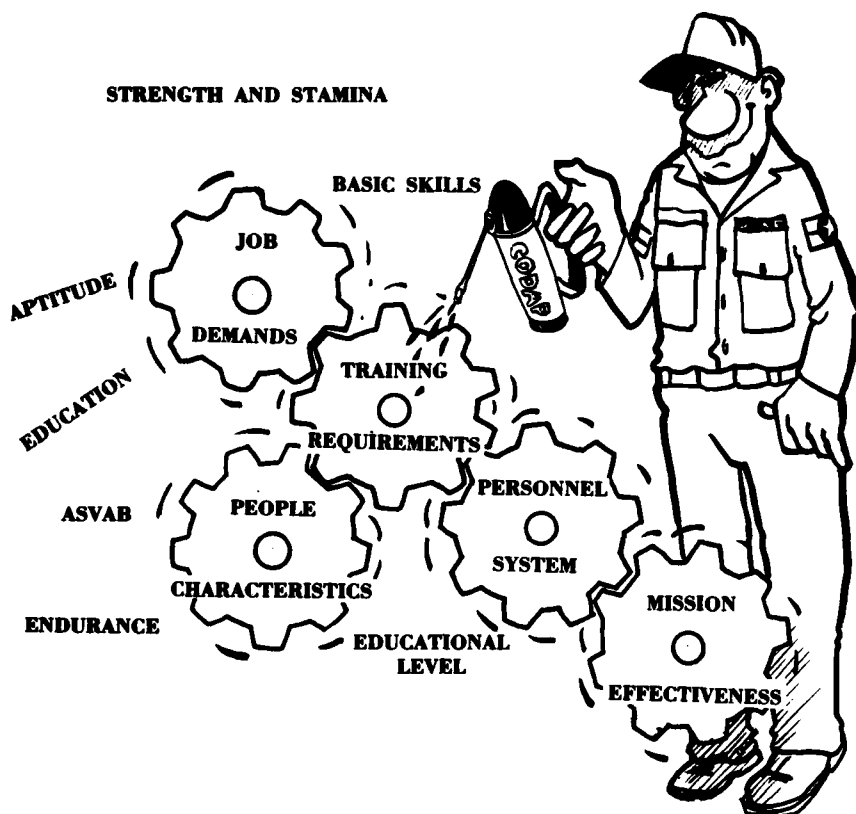
**Benefits:** The results of this research will allow the HIER-GRP program to be applied to a wider class of clustering problems and differential classification than before, and will result in more effective classification of Air Force jobs and improvement of judgment analysis applications such as used in the development of the Weighted Airman Promotion System.



**Weighted Airman Promotion System:  
Provides Equitable/Visible Promotion**



# FORCE ACQUISITION AND DISTRIBUTION SYSTEM



**Title:** Ongoing Development of the Comprehensive Occupational Data Analysis Programs

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AUTOVON 240-2932

**Description:** The Comprehensive Occupational Data Analysis Programs (CODAP) is an occupational data analysis software package that inputs and performs calculations on massive quantities of raw data from job surveys. It was developed in response to the need for an efficient and effective method of identifying and classifying jobs in a rapidly changing Air Force. The basic input to this system is information provided by large numbers of job incumbents in the occupational areas being studied. Because the data are selected at the worker-task level, the CODAP system provides a base of information that may be utilized in many ways to address a variety of predefined and sometimes unanticipated management questions. The technical support during the past year has been aimed at (a)

Application of CODAP Programs  
Facilitates Person-Job-Match

continued enhancement of a methodology for restructuring and summarizing these data for higher-level management in increasingly diverse functional areas, (b) upgrading of the utility and running efficiency of several major CODAP programs to meet the needs of the Air Force Occupational Measurement Center (c) significant improvements in program documentation and software maintainability, and (d) development of several major analytic programs. A major extension of the CODAP system is planned for the coming year. It will involve the development of a package of profile analysis programs for analyzing and clustering anticipated types of data not amenable to standard CODAP analysis.

**Utilisation:** In addition to its ongoing operational uses in updating and evaluating the Air Force officer and enlisted classification structures and in developing and validating the content of training programs, CODAP is now being employed to develop a scientifically sound basis for realigning entry-level

aptitude requirements across Air Force career fields and to address questions about the requirements of jobs, all of which will be integrated into the initial personnel selection process and eventually into the Person-Job Match model. Currently it is also being integrated into the Air Force Specialty Knowledge Test development program as the most effective means of assuring the job-relatedness of test content. The successful implementation of task-analysis procedures in Instructional Systems Development will depend heavily on CODAP data and analytic techniques. Although developed by the Air Force, all branches of the Department of Defense, as well as the British, Canadian, and Australian Forces, have incorporated CODAP into their operational programs. In the public sector, many state and county governments are using CODAP (a) to validate their traditional testing and selection procedures, (b) to validate job and

performance procedures, and (c) to improve job classification and training criteria. Educational institutions are using CODAP to modify their vocational education curricula. During the past year, the Air Force CODAP software has been sent to the Army and Marine Corps to help them update their CODAP systems. Also, the Los Angeles School District and the Institute of Nuclear Power Operation were provided with the CODAP software package. AFHRL is currently making CODAP runs for and providing consultation to the Department of Health and Human Services to assist them in analyzing jobs in the Program Analysis job series. Based on their experience with CODAP in this study, the Department is planning to put the CODAP system on their own computer and use CODAP as the basic tool for analyzing several other job series in the Department.

**Title:** Selection for Pilot/Navigator  
Flying Training

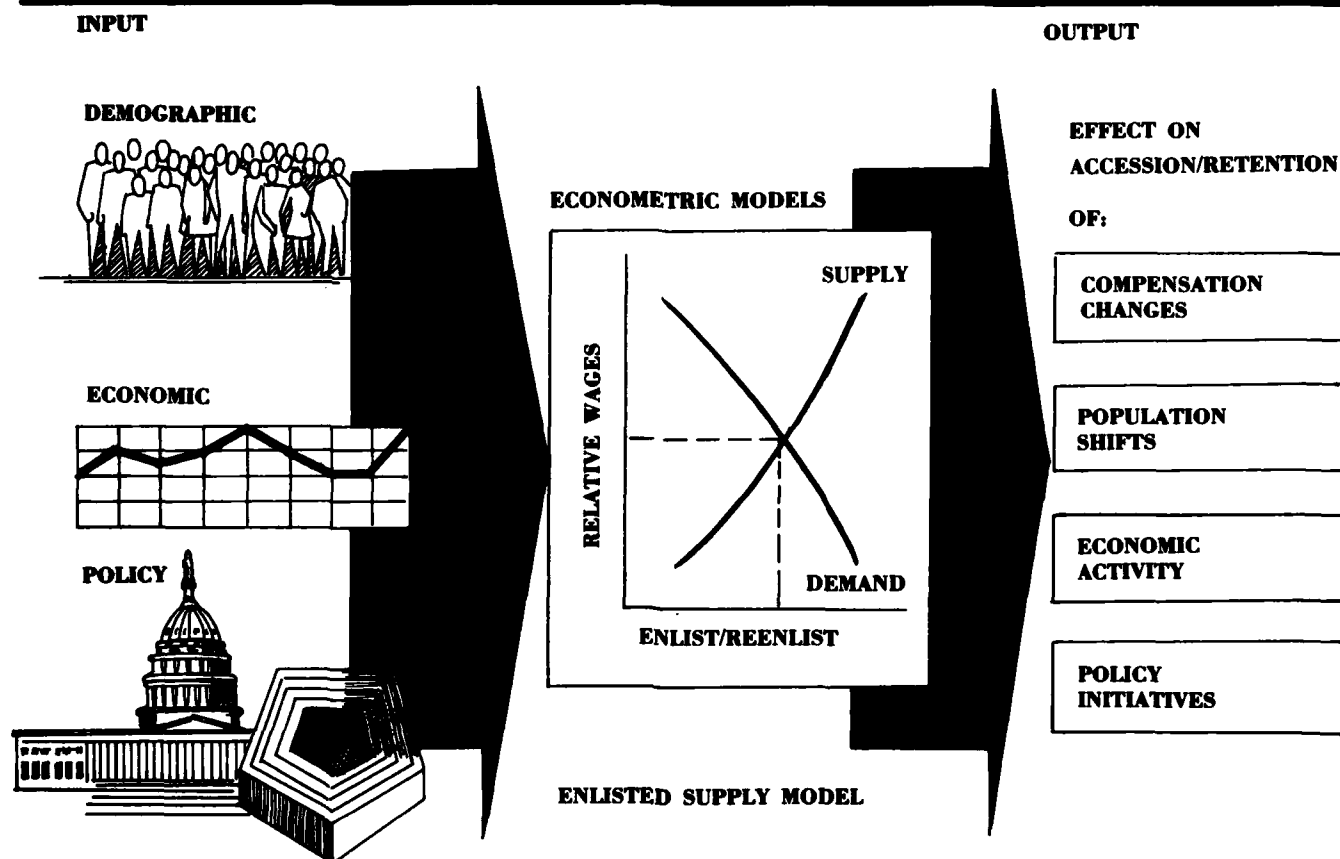
**AFHRL Contact:** Jeffrey Kantor  
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**Description:** The increasing complexity of USAF aircraft and the wide range of operational missions in which they are employed demand the highest possible performance from all aircrew. The goal of this R&D is to enhance pilot and navigator quality by improving the process through which they are selected for training. New measures of candidates' abilities which predict success both in flying training and the operational squadron will be used. A program which is well underway will add information about pilot candidates' psychomotor skills to the existing selection decision variables, i. e., the Air Force Officer Qualifying Test (AFOQT) and the Flight Screening Program. Preliminary results indicate that the integration of these measures of perceptual motor skills with the existing decision variables could reduce pilot training attrition by 4-5%. Approximately 1900 pilots are trained annually and the average cost of a student pilot dropping out of flying training is \$68,000. A conservative estimate of 4% attrition reduction would result in a cost savings of over 5 million dollars annually, using these new selection techniques.

A second R&D effort is obtaining information about candidates' cognitive abilities, such as information processing and decisiveness, and will add these to the selection decision. A parallel program predicted success in Navigator Training with an experimental Basic Navigator Battery. Some of the test items will be included in the Navigator-Technical composite of the AFOQT. Additionally, programs are underway to obtain measures of performance for operational squadron flying. These measures are intended to expand the criterion for evaluation of the prediction information to include combat mission effectiveness.

**Utilization:** The additional prediction measures will be used by the Air Training Command to improve selection systems for pilot and navigator training. Additionally, the results of the R&D measuring combat mission effectiveness will assist the classification decision into fighter or non-fighter aircraft for both pilots and navigators. This information will be especially useful with the advent of Specialized Undergraduate Pilot Training and its requirement for an early track selection decision. The improvement of the pilot and navigator selection systems will provide students better suited for the demands of training and the combat mission.

# FORCE ACQUISITION AND DISTRIBUTION SYSTEM



**Title:** Estimation of Air Force Enlisted Manpower Supply

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**Description:** During the past 3 years, econometric R&D in the Air Force enlisted accession and retention market has resulted in the development of a data file for analyzing the impact of changes in civilian and military economic and policy parameters on the distribution of enlisted personnel by specialty, experience, and aptitude. The data file was used also to econometrically derive the necessary relationships for performing these impact analyses, both Air Force-wide and in selected levels of occupational specialty and/or quality groupings.

A 2-year extension to the original contract is providing for a detailed analysis of accession and retention within specific Air Force specialties (AFSs). A model is under development to facilitate forecasting the effects on total-force accession and retention of various policy and economic variables. Theoretical work on the

supply-demand relationship developed earlier in this effort is being used as the basis for an examination of individual AFSs as well as groups of AFSs. After individual or subgroups of AFSs have been examined, the integrative model will permit the aggregation of the various AFS categories into a total system for studying such topics as the costs and benefits of retraining, prior-service enlistments, effects of the GI Bill on accession and retention, and effects of retirement policies on the force structure.

Work under this task has been expanded to provide a methodology for predicting future retention trends for the Air Force at large and for selected AFSs, and to quantify the impact of selective reenlistment bonuses on Air Force retention.

**Utilisation:** The results of this effort will provide Air Staff offices with quantitative means for justifying various programs to the Office of the Secretary of Defense and to Congress. As an example, this effort should demonstrate the cost effectiveness of the selective reenlistment bonus program. Other results should enable Air Force planners to make effective use of fiscal resources to meet accession and retention goals.

**Title: Validation of Officer Training School and Air Force Reserve Officer Training Corps Selection Systems**

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AUTOVON 240-2257

**Description:** The Officer Training School (OTS) and the Air Force Reserve Officer Training Corps (AFROTC) both use central selection boards to select applicants and to fill program quotas. The selection boards differ somewhat in approach, but the goals are identical: to select the best qualified personnel from among the applicants. The primary difference in the two selection processes is that AFROTC uses the Weighted Professional Officer Selection System, which was developed through policy capturing. In this system, 11 weighted variables are used to develop a quality index score. For OTS, selection is made entirely by boards, and the selection process does not involve empirically weighted variables. The two selection processes will be compared, and each system will be validated against performance prior to commissioning and at several career points after commissioning.

**Utilization:** The results will be used to refine and improve the selection of OTS candidates and AFROTC cadets for the professional officer course and subsequent commissioning. This improvement should result in the selection of high-quality officer personnel and the reduction of attrition in officer training programs.



OTS Students being Sworn in as  
Commissioned Officers

**Title: Development of an Air Force Occupational Research Data Bank**

**AFHRL Contact:** 1Lt Richard H. Brown  
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AUTOVON 240-2932

**Description:** Efforts to establish an Air Force Occupational Research Data Bank have resulted in the development of an on-line rapid access retrieval system for different kinds of occupational data. This retrieval system includes summary-descriptive variables about Air Force occupations, occupational survey data for the enlisted occupations, and a research report index system by occupations. The retrieval system provides the capacity to reference research materials through a cross-catalogued key word search and to select, display, and print variables related to occupational descriptors. It also allows the user to extract various Comprehensive Occupational Data Analysis Programs (CODAP) reports. In addition, longitudinal analysis and cross-occupation analysis capabilities are built into the system. At present, these prototype systems within the Occupational Research Data Bank are operational. Work has been directed towards the interface of statistical and occupational survey data and the development of an occupational aptitude requirements subsystem.

**Utilization:** The Occupational Research Data Bank has been designed to support the R&D thrusts of AFHRL. The large volume of occupational data contained in the retrieval system provides a centralized location for researchers to obtain quick-response answers for questions regarding the characteristics of specialties, such as mean test scores, ethnic mix, and geographical distribution. Without using the Occupational Research Data Bank capabilities such questions may take weeks to answer. Cross-comparisons of specialties with respect to their characteristics are feasible and should lead to more effective selection of occupations for special studies. Personnel and training data from calendar years 1978 through 1981 are presently available. CODAP reports from calendar years 1978 through 1983 are available also.

## **FORCE ACQUISITION AND DISTRIBUTION SYSTEM**

**Title:** Analysis of Manpower Projection of Skill Requirements

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AUTOVON 240-3047

**Description:** This effort will develop and evaluate alternative techniques for projecting skill requirements corresponding to alternative compositions of program elements, accounting for technological changes currently being implemented. The methodology is as follows:

1. Categorize selected Air Force Specialties according to growth, shrinkage, stable or mixed patterns since 1977.
2. Determine the timeliness with which changes in the Five-Year Defense Plan are reflected in the manpower data files.
3. Analyze how changes in, and uncertainties about, the implementation timing of major force programs or changes thereto affect the timeliness, completeness, and accuracy of the data files.
4. Determine the impact of program element changes on Air Force Specialty distribution patterns, and assess how discrepancies between predicted and actual program levels vary as the prediction period shrinks.
5. Describe the needs for and uses of skill projection data throughout the Air Force manpower, personnel, and training systems.
6. Analyze commonalities between skill projection and other Air Force requirements analysis tools, such as functional and program estimating equations.
7. Review skill projection techniques used by other military, government, and civilian organizations.
8. Synthesize and evaluate alternative methods of skill projection for effectiveness in the Air Force management structure.

**Utilization:** This R&D will provide a firm conceptual and operational foundation for the future development of a skill projection modeling system to assist in the manpower and personnel planning and budgeting process. Such a system will enable manpower management to estimate more accurately and promptly the skill requirements for various program element combinations. This effort will result in an evaluation

and synthesis of alternative methods of skill requirements projection in light of available resources and operational needs. The R&D will include consideration of how to incorporate the impact of known technological changes expected to be implemented during the projection period. Ultimately, application of such a modeling process will greatly aid in ensuring that manpower is appropriate to the Air Force mission and that personnel are available in sufficient quantities with the proper skills to accomplish mission requirements.

**Title:** Enlisted Assignment/Reassignment Research

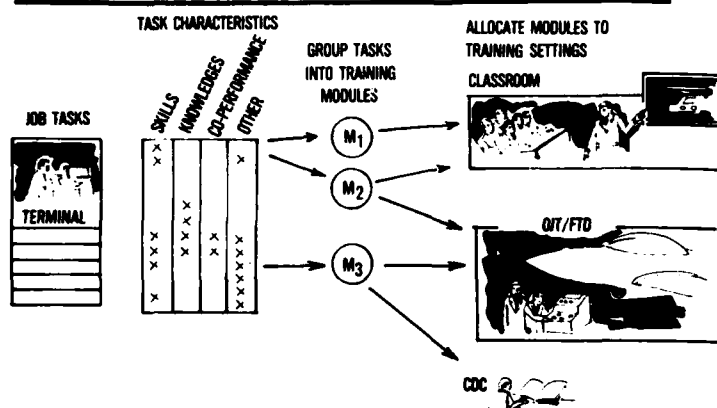
**AFHRL Contact:** Manuel Pina, Jr.  
AFHRL/MOMP  
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AUTOVON 240-2187

**Description:** This work supports the assignments function of Air Force personnel management. The object of this project is to develop assignment technology which will be used by the Air Force in the Person-Job Match area. The following is the initial list of planned work:

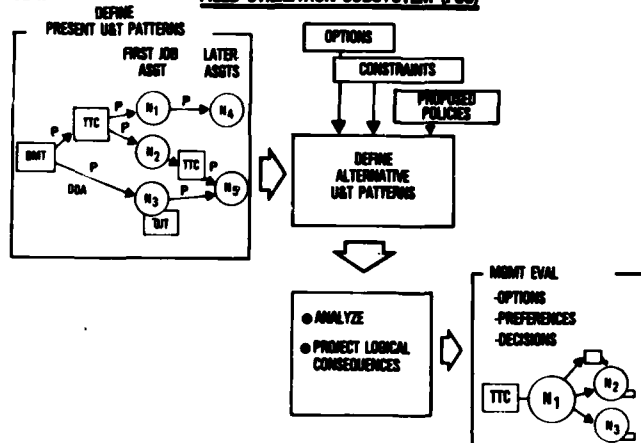
1. Design two alternative systems for assigning airmen to geographic locations.
2. Assist the Air Force Recruiting Service transfer the Procurement Management Information System (PROMIS) software to the newly acquired Honeywell system, which is the assignment optimization portion of PROMIS.
3. Develop the post-PROMIS assignment methodology for implementation of variables already available for the selection and classification of recruits.
4. Develop a PROMIS II assignment methodology. Implement presently used variables and define through R&D new variables to be used in the selection and classification of recruits.
5. Develop a library of R&D software in the operations research and manpower area to support the personnel assignment optimization program.

**Utilization:** The alternative computer-based systems for assigning airmen to geographic locations will be designed to replace the present manual system. This will relieve management of much time-consuming work. The PROMIS assignment methodology will enhance the present preenlistment assignment methodology with additional relevant variables.

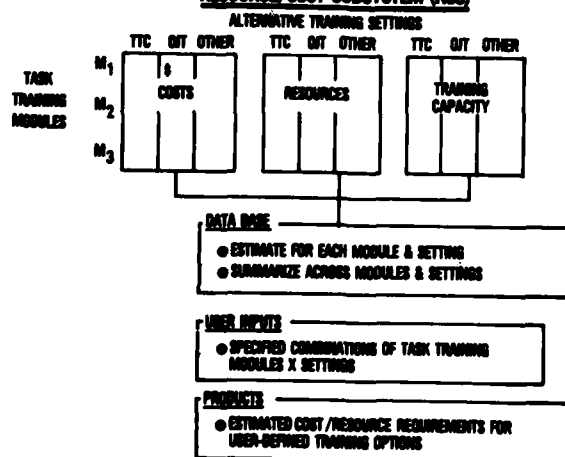
## PHASE I TASK CHARACTERISTICS SUBSYSTEM (TCS)



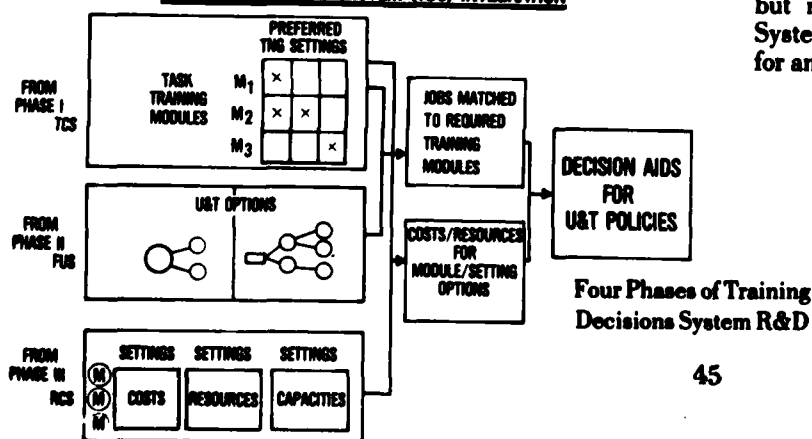
## PHASE II FIELD UTILIZATION SUBSYSTEM (FUS)



## PHASE III RESOURCE/COST SUBSYSTEM (RCS)



## PHASE IV TRAINING DECISIONS SYSTEM (TDS) INTEGRATION

**Title: Research and Development of a Training Decisions System**

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**Description:** The objective of this effort is to develop a user-oriented, interactive, computer-based system for training resource allocation and training assignment decisions. The effort will involve the exploratory development of four subsystems: (a) a task characteristics/task clustering subsystem to address the what and where of training, (b) a field utilization subsystem to address the consequences of training decisions in terms of personnel assignment strategies and mission accomplishment, (c) a resource/cost/capacity subsystem to assess the resource and capacity constraints and cost tradeoffs of training decisions, and (d) an integration subsystem to interface the other subsystems and aid in developing optimal utilization and training policies.

**Utilisation:** This effort will produce a training decisions system that will provide readily available, validated information to the Air Staff and user commands, especially the Air Training Command, on costs and consequences of training decision alternatives under different constraints, costs, and personnel utilization patterns. The following benefits are anticipated from the implementation of such a system: (a) enhanced mission readiness through optimizing the match of technical training resources and overall operational demands, (b) increased training efficiency through optimizing the sequence and settings in which training occurs, (c) improved personnel utilization through development of methods for analyzing functional job patterns in relation to optimized training sequences, (d) increased cost effectiveness of training through the formulation of training decisions based on explicit cost and resource consequences, and (e) reduction of excessive operational training commitments through more accurate estimation and analysis of unit capacity to train while meeting ongoing mission demands. This effort will be supportive of, but not duplicate, a parallel effort by the Training Systems Division of AFHRL to develop specifications for an integrated training system for on-the-job training.

## FORCE ACQUISITION AND DISTRIBUTION SYSTEM



ASVAB Working Group Meeting

**Title:** Development of Follow-On Forms of the Armed Services Vocational Aptitude Battery

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AUTOVON 240-3256

**Description:** In calendar year 1984, additional forms of the Armed Services Vocational Aptitude Battery are scheduled for operational implementation. Item writing and subtest construction have been accomplished. Development of conversion tables is in progress. ASVAB Forms 11, 12, and 13 are scheduled for operational implementation in October 1984.

**Utilization:** ASVAB is revised periodically to maintain integrity of the battery and to incorporate improvements. It is used by all of the Armed Services to select and classify enlisted personnel.

**Title:** Chained Equating

**AFHRL Contact:** Malcolm James Ree  
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**Description:** Historically, military enlistment tests have been normed to previous tests through a technique known as equating. Often, this involves equating a new test to an old test which, itself, has been equated to a previous test. Sometimes, these chains extend to include six equatings and the possibility of scale drift exists. This study investigates consequences of these chains in equating and the likely magnitude of "drift."

**Utilization:** The ASVAB (and other military tests) is revised and equated to previous tests. Any unintentional consequences must be evaluated and avoided where possible. This study supports the joint-Services selection and classification program.

**Title:** Enhancement of Officer Occupational Survey Technology

**AFHRL Contact:** Louis Datko  
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AUTOVON 240-3222

**Description:** Occupational Survey/Comprehensive Occupational Data Analysis Programs (OS/CODAP), a technology developed for Air Force enlisted specialties, has produced sizable benefits for the Air Force over the years. Empirically derived job indices have guided decision makers in such areas as classification and occupational structure, training requirements, and personnel assignments. However, comparable occupational survey technology for officer specialties is still in the formative stages. The need exists to improve the measurement technology for officer jobs so that problems in career development, classification, and training, for example, can be broached from a firm empirical knowledge base. Work is presently underway to extend the OS/CODAP technology to officer specialties and to develop new measurement techniques when the enlisted technology cannot be directly transferred. Specifically, the objectives are as follows: (a) develop and test job descriptive scales as alternatives to relative time spent, (b) establish the utility of existing task factor scales, (c) develop and test alternate task factor scales where needed, (d) identify appropriate samples for collecting task factor data, and (e) develop CODAP products to display officer data for specific users.

Preliminary analyses of needs assessment data collected to determine a rank-ordered set of needs for officer occupational data have yielded the following results. The raters assessed all officer occupational data needs as important to the total Air Force mission and demonstrated high levels of agreement in their ratings and rankings. The raters found that the primary officer occupational data could be useful in the areas of determining training relevance, validating job prerequisites, and assessing officer attitudes regarding such factors as utilization of talent and training, job interest, and sense of accomplishment.

A number of candidate job descriptive scales have been investigated. The Part-of-Job Scale, a modification of Hemphill's Part-of-Position Scale, was chosen as the most feasible alternative to the operational time-spent scale. The rationale for the Part-of-Job scale is to gain more differentiation among tasks commonly performed by most officers. Data collection efforts are underway in four officer utilization fields: Aircraft Maintenance/

Munitions, Computer Systems, Manpower Management, and Security Police.

**Utilization:** Officer occupational surveys will ultimately be developed using validated task factors and job properties singly or in combination. The technology developed will provide the means for establishing an empirical database for use by Air Force decision makers regarding utilization of officer personnel. Enhanced officer occupational survey methods will benefit the Air Force in terms of a more effective classification system, more clearly defined educational requirements, and cost savings in training.

**Title:** Learning Abilities Measurement Program

**AFHRL Contact:** Lt Col David L. Payne  
AFHRL/MOE  
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Commercial (512) 536-3570  
AUTOVON 240-3570

**Description:** The Learning Abilities Measurement Program (Project LAMP) is exploring ways to identify and define the fundamental parameters of learning abilities. While the project is devoted to basic research, it is nevertheless goal oriented. The primary objective is to develop ability measures that can be used to forecast the rate at which individuals will acquire skills and knowledge. A second objective is to forecast ultimate levels of performance capability. Both of these criteria have been adopted because it has not been clearly established that individuals who are fastest at initial skill acquisition are necessarily those who reach the highest level of performance capability.

Project LAMP was initiated in recognition of the fact that there has been very little advancement in the state of the art in ability measurement during the past 25 years. The present availability of modestly priced microcomputers and other measurement devices creates the possibility of a major breakthrough. It appears that the first significant advance will be in the area of adaptive testing, which is being vigorously pursued by the military services. Adaptive testing promises to save testing time, yield better measurement at the extremes, and avoid the costs associated with frequent test replacement and norming necessitated by test compromise. Research currently in support of adaptive testing is targeted toward more efficient measurement of abilities tapped by present conventional paper-and-pencil tests. Project LAMP, on the other hand, is oriented toward the measurement of abilities currently not evaluated by conventional tests.



## FORCE ACQUISITION AND DISTRIBUTION SYSTEM

Four approaches have been adopted for Project LAMP as an initial attack on the problem.

1. Evaluate parameters of short-term learning curves as predictors of skill acquisition, decay, and reacquisition. Many of the conventional ability measures are primarily measures of knowledge levels. For example, the word knowledge test in the present Armed Services Vocational Aptitude Battery (ASVAB) measures how many words individuals have learned during their first 18 or 19 years of life experience. Such a test is also an indirect measure of learning rate, but it is an imperfect indicator due to differences in past learning opportunities and motivation. It is hypothesized that parameters extracted from short learning tasks administered under laboratory conditions will provide better prediction of subsequent learning behavior than can be obtained from the static knowledge measures represented in presently available conventional test batteries.

2. Identify new abilities. The availability of new measurement devices now makes possible the evaluation of abilities which cannot be easily tapped with paper-and-pencil tests. Initial research under Project LAMP will be centered on the measurement of memory abilities, automaticity of cognitive skills, and attentional resources.

3. Evaluate cognitive tasks as replacements for or additions to conventional paper-and-pencil tests. During the past two decades, cognitive psychologists have developed a large number of tasks that measure various aspects of information processing skills. Most of these tasks are designed for administration by microcomputer or other electronic devices, and the emphasis has been on the measurement of response latencies as indicators of the speed and efficiency of mental functioning. Recently, large individual differences have been observed on such cognitive tasks.

4. Conduct in-depth analyses of conventional tests. The abilities measured by conventional paper-and-pencil tests are important predictors of future learning. However, these abilities might be measured more efficiently by the microcomputer. Microcomputer administration can also yield additional information, such as the speed of information processing, which cannot be easily obtained in the paper-and-pencil format. Conventional tests will be studied under Project LAMP to determine how they should be reformatted for microcomputer administration in order to yield the maximum information related to individual differences in learning abilities.

**Utilisation:** Basic research in personnel measurement is needed to rejuvenate a mature technology and to advance the state of the art. Computerized cognitive tests hold promise as supplements to or replacements for conventional ability measures. They may measure some abilities more reliably and quickly than conventional paper-and-pencil tests, and they may measure useful abilities that cannot be measured at all by conventional tests. The project is expected to establish a test base of possible alternative aptitude measures for use in the development of operational tests for both enlisted and officer personnel.



More than 40 computer testing stations are part of the AFHRL Experimental Testing and Learning Laboratory located at Lackland AFB.

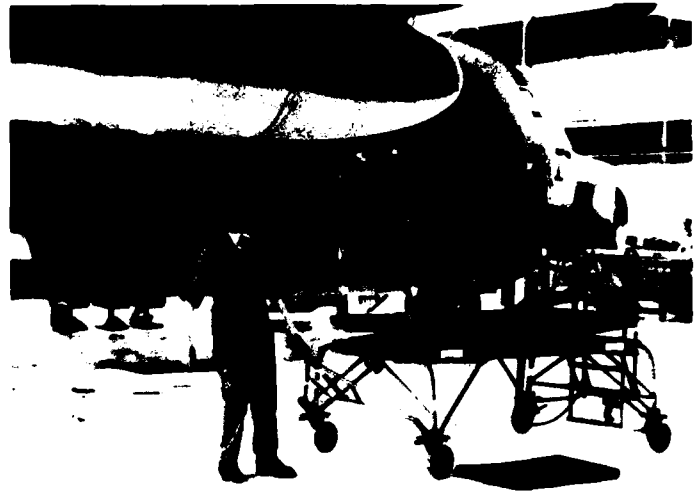
**Title:** Assessment of Physical Strength and Stamina Requirements in Air Force Specialties

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**Description:** Each Air Force enlisted specialty is presumed to differ in the nature and extent of physical capabilities required for successful job performance. Moreover, in a variety of specialties, effective performance requires above average physical strength and stamina from incumbents. Despite these prevailing conditions, little systematic R&D has previously been done to support definitive assignment criteria to ensure that personnel capabilities meet requirements. A comprehensive two-stage assessment of the physical occupational requirements in 188 enlisted specialties has now been completed. Approximately 16,000 supervisors worldwide have rated more than 67,000 occupational tasks for purposes of identifying, defining, and quantifying physical demand requirements within specialties. Results from the first stage of the assessment have shown that supervisory personnel can reliably identify and rate physically demanding tasks and thereby provide the empirical base for specialty-specific task demand profiles. These results, along with a framework to use in combining task-level estimates to produce an index of demand for an entire specialty, have been documented in the first of a series of technical reports. A follow-on study will validate the occupational ratings using actual field measurements.

Ongoing and future R&D activities include the formulation of regression models to establish the predictive accuracy of specific task parameters and to benchmark and compare demand characteristics across specialties. Moderator variables such as numbers of first-termers performing the tasks, time spent in task execution, and consequences of inadequate performance will be closely studied.

**Utilisation:** Physical demand indices will ultimately be incorporated with the Person-Job Match system as additional factors to be considered for the optimal assignment of individuals to jobs. Further refinement of the algorithm with physical demand factors is especially important in view of current accession trends, namely, declining numbers of qualified male enlistees and the concomitant increase in the proportion of females serving in the Air Force.



In a variety of Air Force specialties effective performance requires above average physical strength and stamina from incumbents.

**Title:** Development of an Integrated System to Assess and Enhance Basic Job Skills

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**Description:** The ever-growing technological sophistication of Air Force equipment and systems and the projected decline in the size of future military labor pools provide the basis for this investigation into the basic job skills required in Air Force enlisted occupations. Basic job skills are defined as the core knowledge and ways of using that knowledge that enable first-term airmen to develop proficiency on the job and to begin progression to more skilled levels. Plans have been formulated to develop and apply an integrated assessment and enhancement system that will (a) scientifically derive and validate basic skill job requirements, (b) assess concomitant skills of enlisted personnel, and (c) provide design specifications for training to remediate personnel deficiencies. In addition, a preliminary feasibility study has been initiated to examine the applicability of cognitive task analysis techniques for this Air Force inquiry.

## FORCE ACQUISITION AND DISTRIBUTION SYSTEM

Multiple concurrent efforts are contemplated with respect to the three integrated system components: job measurement, personnel measurement, and training design. Air Force occupational survey technology will be used in both data collection and data analysis phases, the initial application being a test of the feasibility of the job inventory (task level) approach to the measurement of basic skill job requirements in a selected group of occupational clusters. For the job measurement phase, both multiple data sources (e.g., job incumbents, supervisors, training instructors, training and job materials, personnel basic skills proficiency data) and data collection methods (e.g., paper-and-pencil survey, interview, materials evaluation, task performance assessment) will be used in various combinations. Additionally, techniques for routinely updating the job requirements database will be investigated. Personnel measurement milestones will involve test identification and development to validate identified skill requirements and to diagnose individual skill deficiencies. Empirical job requirements and personnel performance data will then be used as the basis for designing training modules to remediate deficiencies and to equip job incumbents with the basic skills needed for job proficiency and career progression.

**Utilization:** This effort is part of a comprehensive R&D program undertaken by AFHRL to improve classification, assignment, and training systems through empirical determination of enlisted force job requirements. After an advanced development phase, the job-oriented, basic skills training program will be proposed to replace the existing basic skills programs that are not functionally oriented.

**Title:** Development and Validation of Officer Selection and Classification Tests

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**Description:** Analyses are in progress on the Air Force Officer Qualifying Test-Form O (AFOQT-O) that was implemented September 1981. A large item pool for use in AFOQT-P and subsequent forms is under development. Officer Screening Composites were developed for recruiter use to estimate how well an officer applicant might score on the AFOQT. A large AFOQT database spanning forms L through O has been developed. Analysis and evaluation of this database will determine the need for modification or changes

in the test format, content, and scoring procedures. Continuing efforts are ongoing to evaluate usefulness of the AFOQT for selection into officer training schools such as Pilot, Navigator, and Missile Officer.

**Utilization:** The AFOQT is used in conjunction with other variables by the selection boards of the Officer Training School and the Reserve Officer Training Corps to select civilian and military applicants most likely to succeed in officer training and subsequent career assignments. The Officer Screening Composites provide the applicant and the recruiter instant feedback indicating how well the applicant might score on the AFOQT. The recruiter uses the results of the Officer Screening Composites to rank order the applicant in the processing cycle.

COPY NO. 94008

CONTROLLED ITEM  
(TEST MATERIAL)

UNITED STATES AIR FORCE  
OFFICER QUALIFYING TEST

TEST BOOKLET

FORM O



COPY NO. 94008

DO NOT WRITE YOUR NAME OR MAKE YOUR ANSWERS IN THIS BOOKLET

AF FT 100  
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Latest Form of AFOQT



AFHRL evaluates aptitude requirements  
for Air Force enlisted job specialties.

**Title:** Evaluation of Aptitude Requirements for  
Air Force Enlisted Job Specialties

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**Description:** Given the all-volunteer recruiting environment and projections of a decreasing manpower pool during the 1980s, occupational aptitude requirements must be accurately stated and available manpower be assigned to those occupations where their talents are most needed. A methodology has been developed that evaluates aptitude requirements and produces measures of learning difficulty for each enlisted job specialty. Initial learning difficulty is generated on a position-by-position basis and is derived from expert judgments of task-learning difficulty and time spent performing. To derive an index of the learning difficulty for an occupation, learning difficulty is averaged across occupational positions.

To date, the methodology has been applied to over 200 enlisted job specialties representing the mechanical, administrative, general, and electronics aptitude areas. This effort involved on-site observation and evaluation of learning difficulty for over 10,000 tasks by two independent teams of experts and the calculation of learning difficulty for well over 100,000 tasks for more than 170,000 incumbent positions. Although the methodology was initially validated by comparing task-level judgments from independent raters and different rating procedures, work is being planned to provide additional validity data. This effort will involve comparing absolute measures of task-learning time with judgments of task-learning difficulty. Other follow-on efforts will involve research to support transfer of the task rating methodology to the USAF Occupational Measurement Center for implementation.

**Utilisation:** Measures of occupational learning difficulty provide an empirical, job-centered frame of reference that can be systematically utilized in the evaluation of occupational aptitude requirements.

## FORCE ACQUISITION AND DISTRIBUTION SYSTEM

Measures of occupational learning difficulty served as a basis for the first extensive review of job requirements in 25 years. As a result of this review, adjustments in aptitude requirements were made for 100 enlisted specialties and were formally implemented in the April 1982 update of Air Force Regulation 39-1. Learning difficulty information has also been delivered to Air Force Recruiting Service where it has been implemented through the computerized job reservation system. In addition to areas of formal implementation, there are three areas of potential application: (a) learning difficulty data could be used to redesign or restructure occupations to reduce occupational learning loads, (b) with additional research, it may be possible to design and/or evaluate technical training courses on the basis of the learning difficulty of tasks as they are performed in the field and thereby increase the linkage between job performance and technical training, and (c) these data have potential applications in the area of job performance. Knowledge of the learning difficulty of tasks can guide decisions concerning the development of fully proceduralized job performance aids.



Basic Attribute Test (BAT) Station

**Title:** Computerized Basic Attributes Test System

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**Description:** Previous R&D has demonstrated the utility of measures of perceptual-motor abilities for the selection of personnel for pilot and navigator training and for technical training. The interest in these measures has been revived, following the discontinuance of apparatus testing in the 1950s, as computer-based testing techniques and the use of highly reliable solid-state components have become more widespread. These developments have eliminated most of the difficulties inherent in earlier electro-mechanical testing equipment. Solid-state electronics testing devices have been developed which administer two tests for psychomotor coordination. These devices have been used to collect data from a large sample of individuals slated for pilot training. These individuals are being tracked through training and the relationships between the test scores and training performance determined. Additionally, in response to user requirements for enhanced classification decision systems to support dual-track flying training, a computerized Basic Attributes Test (BAT) system has been developed. This testing system is designed to develop and implement a wide variety of human attributes tests with particular emphasis on information processing consistent with aircrew workload and perceptual-motor requirements. Work is currently underway to demonstrate the usefulness of the BAT for pilot and navigator selection. Subjects are being tested prior to their entry in training, and performance measurements throughout their training are being collected. Measures derived from this battery which show promise when assessed in a laboratory setting will later be incorporated into field-transportable testing devices for possible use in an operational setting.

**Utilization:** The BAT system may be used by recruiting and assignment agencies and by the Air Training Command for the selection and classification of rated officers. The use of tests of perceptual-motor abilities will result in the reduction of attrition from training and a corresponding reduction in training costs.

**Title: Advanced Research on Adaptive Testing Systems**

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**Description:** Traditionally, in the Air Force and elsewhere, standardized aptitude and abilities tests have been given to applicants for employment. Among other characteristics, these tests must be fair and accurate. They must be valid for predicting some useful criterion such as performance in technical training school or performance on the job. When the same test is administered to every applicant, accuracy of measurement is limited to a restricted range around the average difficulty of the test. Without making a test exceedingly long, uniform accuracy across the entire breadth of the measurement scale cannot be achieved. Computerized adaptive testing is a name given to a number of related techniques for presenting an appropriate subset of items from a very large item pool, thus avoiding the presentation of inappropriate items. A goal-oriented series of efforts is underway to develop both prototype and operational item pools, as well as to advance the state of knowledge in the theoretical basis of adaptive testing. Among these studies are pioneering efforts in linking of item statistics and analytic derivation of standard errors of Item Response Theory item parameters. Joint-Service efforts to implement adaptive testing operationally for enlisted selection and classification are in progress. AFHRL is responsible for development of large calibrated item pools for the planned system. These item pools have been developed and calibration is near completion.

**Utilization:** Adaptive testing is usually based on Latent Trait Theory and serious gaps exist in the body of theoretical knowledge. These efforts are directed at extending the knowledge base as it applies to the Laboratory's responsibility to the Computer Adaptive Testing Interservice Coordinating Committee. This work is necessary to achieve the tasking under this commitment. Adaptive testing will eventually be used in developing and norming Air Force operational aptitude tests and by the Air Force Recruiting Service and the Military Enlistment Processing Command.

**Title: Establish Factor and Occupational Composites for the DoD Institutional Test Battery**

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**Description:** Administration of a form of the Armed Services Vocational Aptitude Battery (ASVAB) is offered free to civilian schools for use in guidance and counseling of students. A new form (14) of the institutional ASVAB, which is parallel to the current operational forms, is planned for implementation at the start of the 1984-1985 school year. Three studies were initiated by AFHRL in support of the institutional program. In the first study, now completed, test composites for the new institutional ASVAB were developed through factor analysis and were empirically related to military service composites. A second set of occupational composites was developed based on service validity studies. A second study is underway in which the institutional ASVAB measures will be compared to similar measures in each of several commercial test batteries using samples of high school students. Data collected in the spring of 1983 have already been analyzed. Additional testing is scheduled for the fall of 1983. A third, ongoing study has obtained school grade and gender norms for ASVAB based on a nationally representative sample from the Profile of American Youth database. These norms are being analytically smoothed to minimize sampling fluctuations. The results of studies involving the institutional ASVAB will be included in a manual and technical supplement for the use of school and recruiting service personnel.

**Utilization:** About one million high school students take the institutional ASVAB annually. Military recruiting commands use institutional testing results to identify and recruit service eligible students who are in their last year of high school. Since institutional ASVAB scores are valid for selection into the Services, additional entrance testing at the Military Entrance Processing Stations is not required, thus facilitating the recruitment process.

## **FORCE ACQUISITION AND DISTRIBUTION SYSTEM**

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**Title:** Revision of English Language Tests for  
Use in Overseas Testing

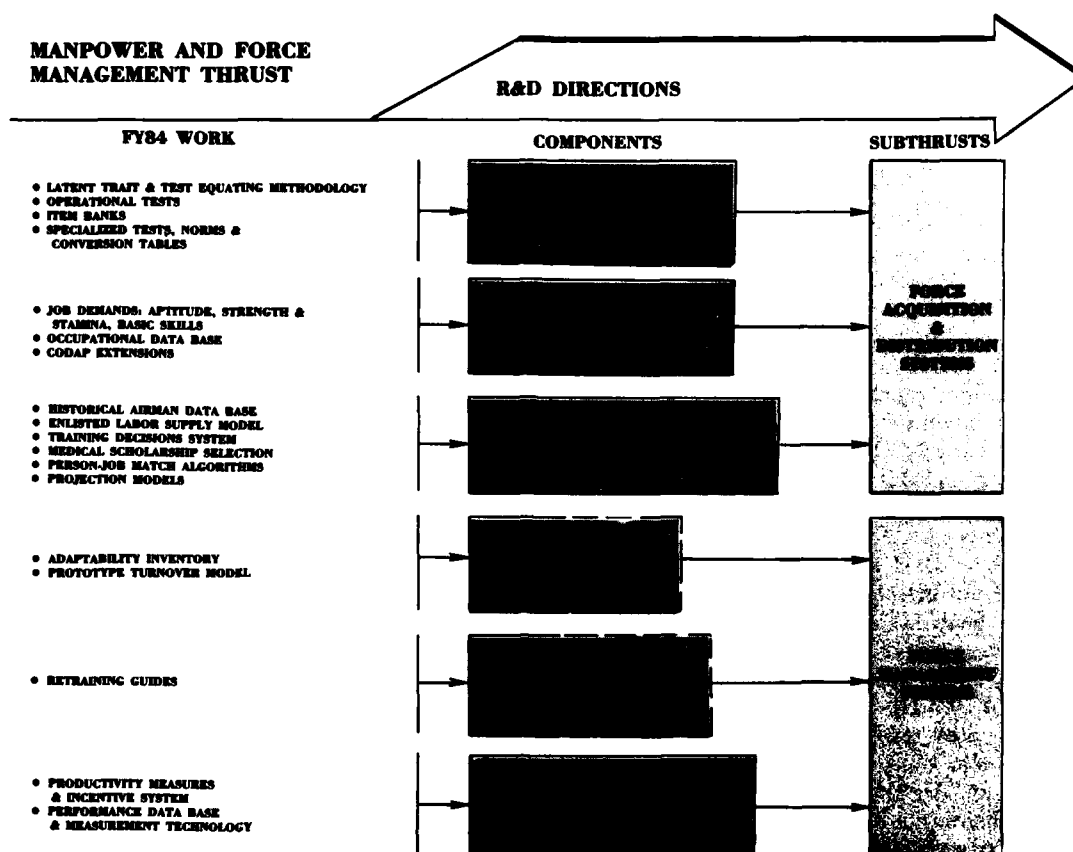
**AFHRL Contact:** 2Lt Thomas O. Arth  
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**Description:** Currently, there are two tests used to evaluate the English language proficiency of foreign nationals hired at overseas bases. They are the Basic English Language Tests (ELTs) and the Intermediate ELTs. The Basic ELTs are composed of picture items and the Intermediate ELTs are composed of word items. They were last revised in 1965 and 1967, respectively, and there was little documentation

regarding their validity. In addition, the Intermediate ELTs tested only reading ability while the Basic ELTs tested reading, writing, speaking, and listening abilities. Currently a revision is being accomplished by developing a new pool of items. These items will be given to a sample of basic trainees to establish that knowledge of English alone is sufficient to respond correctly. They will then be administered to samples of foreign nationals to determine the validity of the revised instruments.

**Utilization:** This effort will result in an improved English language testing battery. These tests will provide all of our overseas bases with instruments to assess the English language proficiency of job applicants. Through their use, problems of test compromise be resolved.

# FORCE MANAGEMENT SYSTEM



## TECHNICAL ACHIEVEMENTS

### **Title:** Selective Reenlistment Bonus Study

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**Description:** The effect of the Selective Reenlistment Bonus (SRB) on retention has been investigated using data from AFHRL's Historical Airman Data (HAD) Base. The HAD Base is an extensive 25 year database composed of historical enlisted personnel data and national economic and policy variables. The SRB study involves an econometric analysis of retention in selected Air Force Specialties (AFSs), particularly those having chronic shortages. The analysis focuses on the estimation of the retention function and seeks to ensure that the most influential institutional and market factors are included. Market factors are represented by such variables as the civilian wage

representing the Air Force's closest competitor for the specialized labor for selected AFSs, the unemployment rate, and G. I. Bill payments for formal training. The institutional factors are comprised of military compensation, reenlistment bonuses, quarterly force level, and others.

**Utilization:** In this investigation, a table of improvement factors showing the effect of applying an SRB has been produced. This table, along with other results, provides evidence whether the SRB will affect career shortages in a skill. This information will be used in justifying elements of the SRB program in reports to Air Force Headquarters, and to the Office of the Secretary of Defense.

**Benefits:** Results from this study will enable Air Force managers to project what the impact of retention would be when SRBs are applied to or taken from an AFS. Such information will enable more efficient use of Air Force funds allocated for retention improvement.



## FORCE MANAGEMENT SYSTEM

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**Title:** Situational Constraints on Performance and Other Work Outcomes

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**Description:** The impact of situational constraints on performance and other work outcomes has recently received considerable attention in the literature and is currently being examined in an Air Force context. This R&D is particularly important since constraints are presumed to inhibit performance, decrease satisfaction, increase frustration, and increase the likelihood of turnover. This work is part of a comprehensive R&D effort concerned with identifying factors influencing performance and productivity. The primary purposes were (a) to develop a taxonomy of situational constraints found in Air Force work settings, (b) to develop objective measures of these constraint dimensions, (c) to validate the constraint measures against work outcomes, and (d) to test hypothesized relationships between constraints and relevant work outcomes within an Air Force context. The work consisted of four phases, and all have been completed. A final technical report is in preparation.

Phase I involved development of a taxonomy of situational constraints applicable to a wide range of Air Force work settings and specialties. An open-ended questionnaire employing a critical-incident methodology was administered to airmen at bases dispersed across the United States and was used to generate specific instances in which situational variables were cited as an explanation for poor performance. A content analysis of the critical incident data resulted in the identification of the following 14 constraints: tools and equipment, training, materials and supplies, job-relevant information, planning/scheduling of activities, time, cooperation from others, personnel, physical working conditions, red tape, forms, policies and procedures, transportation, and job-relevant authority.

Phase II involved development and evaluation of an objective questionnaire to measure the Phase I constraint dimensions. Questionnaires were administered via mail to airmen stationed throughout the world. Preliminary validation of the constraint measures against selected criteria was also accomplished. Significant correlations in theoretically

appropriate directions were observed between dimensional and overall constraint scale scores and satisfaction, frustration, and reenlistment intent criteria.

Phases III and IV involved on-site survey administration to airmen in seven different specialties (AFSs) at four Air Force bases. These phases were designed to validate the refined constraint measure against affective and reenlistment criteria as in Phase II, as well as performance and other criteria. Phase IV involved a large sample to provide in-depth examination of a single AFS, and to test selected research hypotheses. The results of Phases III/IV were mixed and often contrary to expectations. The severity of constraints experienced was lower than anticipated across all AFSs investigated. Perhaps for this reason, a clear or consistent negative relationship between constraints and performance was not observed. Constraints had an adverse impact on some, but not all, aspects of motivation measured. They were also related to thoughts of leaving but not to reenlistment plans. This unexpected finding may be due to a downturn in the economy which made it difficult for those who thought of leaving to actually leave. The strongest and most consistent findings had to do with affective reactions. As in Phase II, constraints were consistently associated with decreased job satisfaction and increased frustration.

**Utilization:** The present R&D effort resulted in the classification of situational constraints commonly found in Air Force work settings. Knowledge of such constraining factors should be helpful to Air Force managers in dealing with performance and productivity problems. Also, the current effort culminated in the development of a refined 42-item measure of constraints. In addition to being used in future R&D, the refined constraint scales can be used by managers as a diagnostic tool for identifying constraints operative in their own organizations, and determining the severity of such constraints.

**Benefits:** Once situational constraints are identified, their severity can be reduced or eliminated. Knowledge of factors that impede performance while increasing job dissatisfaction and frustration will provide managers, in a variety of operational Air Force work settings, with the information they need to make organizational and workgroup-specific changes to enhance performance and provide airmen with a more satisfying work environment.

### **Title:** Retraining and Transferability of Skills

**AFHRL Contact:** Mary J. Skinner  
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**Description:** Research and development has been completed to provide empirically-based information and guidelines for improving the current retraining system. Air Force managers rely heavily on the capability to retrain enlistees from one occupational specialty to another in coping with the continuing problem of manning shortages and overages in career fields. Each year about 10,000 enlistees are retrained to realign manning imbalances. The performance and progress of about 40,000 enlistees who retrained between 1973 and 1977 were evaluated. Comparisons were made between retrainees and non-retrained airmen in service during the same time period.

Results indicated that retrained airmen typically made a smooth and successful transition between military occupations. In formal training programs for their new specialty, retrainees performed better in most schools than did non-retrainees with equivalent aptitudes. Training achievement levels for retrainees were found to depend on aptitude, time in service, and type of previous experience. Results of technical school performance analyses supported the current policy that permits 10 points of the job entry aptitude requirement to be waived for retrainees. A survey of supervisors revealed that they judged the skills, abilities, and performance of retrainees on the job to be comparable to those of non-retrained personnel. Retraining's job attitudes, morale, and motivation indicated that adjustment to the job change was satisfactory. Measures of time to upgrade skill levels indicated that, compared to the average for Air Force members, retrainees progressed at the same or a faster pace. However, promotion indices revealed that opportunity for military grade advancement was somewhat less for retrainees. Retention rates were comparable for retrainees and non-retrainees in their second and subsequent enlistment terms. Comparisons between volunteer and selective (non-volunteer) retrainees indicated that selectees performed at slightly lower levels and had poorer job attitudes.

**Utilization:** Findings were transferred to the sponsors of the research in 1982. Data have since been used in the formulation of a policy which sets a time in service cutoff for retraining non-volunteers. Other applications for reducing some of the negative impacts of programmed selective actions were outlined for

consideration by managers. Further implications exist for the management of the job selection and assignment system for retrainees. Reassignment decisions that take into account the retraining candidates' aptitude, military tenure, background, and volunteer or non-volunteer status would provide better matches between candidates' capabilities and retraining specialty requirements.

**Benefits:** Improved retrainee selection and assignment procedures can be expected to stimulate participation in the program, to favorably impact reenlistment rates, and to increase productivity and satisfaction of airmen in second specialties. Assignments that optimize skills transfer will result in dollar savings through lowered attrition rates, as well as reductions in training time required for retrained personnel to achieve proficiency in their new occupations.



Computer Operator Retrained  
as Computer Programmer

## FORCE MANAGEMENT SYSTEM

### **Title:** Job Performance Criterion Development for the Jet Engine Mechanic

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**Description:** Historically, enlistment standards and selection classification decisions have been linked to success in military training school, rather than to performance on the job. Similarly, other personnel decisions are frequently based on subjective supervisory ratings. To evaluate the predictive relationship between these variables and hands-on performance, the Air Force has begun a 7-year R&D effort to systematically obtain job performance measures that will serve as criteria for validating selection systems, evaluating training programs, and the effects of personnel policies and procedures. The first Air Force Specialty (AFS) selected for development and testing of job performance measures is the Jet Engine Mechanic (426X2).

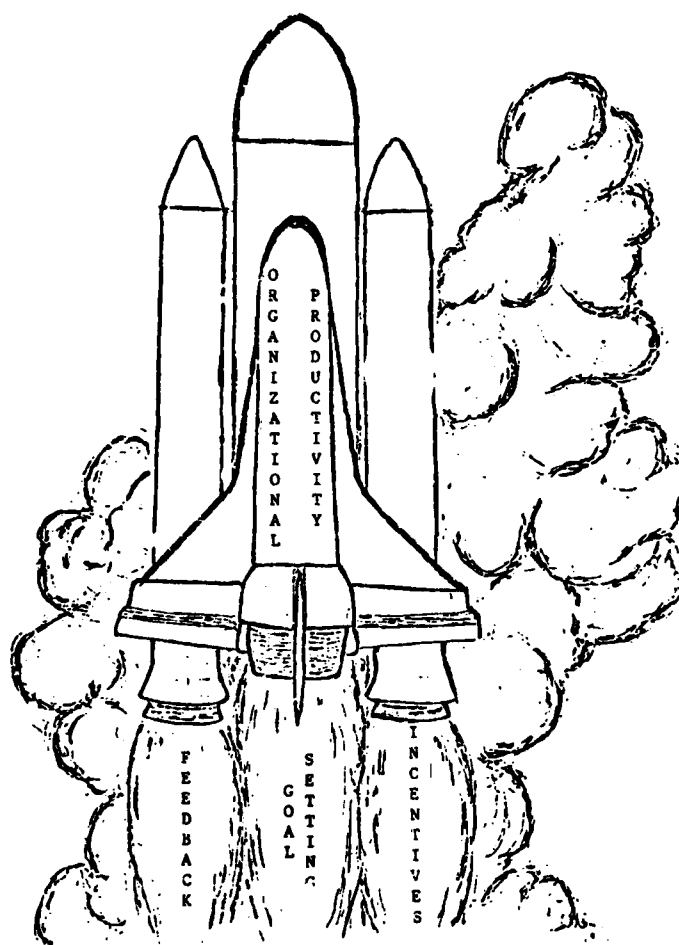
In addition to hands-on job sample tests, a new measurement technique, walk-through performance testing (WTPT), is being developed. The objective of WTPT is to expand the range of job tasks assessed

to include tasks which do not lend themselves to hands-on testing because of cost, time, and/or safety considerations. WTPT is a task-level job performance measurement system that combines tasks performed and interview procedures to provide a high fidelity measure of individual task-oriented capability. The testing methodology will be evaluated as a supplement to hands-on data collection and as a more cost-effective substitute. Further, tests will be tailored to the actual job performed by an individual, not the entire range of tasks included in the 426X2 AFS. Therefore, procedures will be developed, including job experience ratings, to permit rank ordering job incumbents within an AFS. Also, a wide range of alternative job performance measures will be developed in addition to the walk-through testing methodology. These include peer, supervisor and self performance ratings. When job sample, interview and alternative forms have been developed for the jet engine mechanic, their relative utility will be determined.

**Utilization:** These job performance measures are needed for R&D and evaluation of operational Air Force programs and are also necessary to comply with recent Congressional mandates that enlisted selection tests be validated against hands-on job-performance measures. Validation of civilian selection and promotion procedures against job performance measures must also be accomplished.



AFHRL is designing job performance measures for jet engine mechanics



**Title:** Enhancing Productivity in Air Force Organizations Through Feedback, Goal Setting, and Incentives

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**Description:** Past exploratory research primarily in laboratory settings has demonstrated that goal setting, feedback, and incentives improve performance in relatively simple jobs. These encouraging results have increased interest in determining the effects of these technologies on the productivity of work groups performing more complex jobs.

This effort will examine the effects of goal setting, feedback, and incentives on productivity in operational

Air Force organizations. In addition, it will suggest a solution to the important methodological problem of aggregating productivity measures from lower to higher organizational levels. More specifically, this effort has four major objectives: (a) to develop detailed procedures for developing and aggregating productivity indices, (b) to field test the generalizability of goal setting, feedback, and incentives in operational organizations involving more complex jobs than those found in previous R&D, (c) to determine how much these enhancements increase productivity and how acceptable they are to Air Force personnel, and (d) to develop practical manuals that describe how managers can design and implement these measurement and enhancement technologies.

**Utilization:** The productivity measurement system will provide productivity information at the work group level which could be aggregated for the entire organization. This system may be used to specify the strategy that personnel in organizations could use to enhance their productivity based on current mission requirements. In addition, information as to how feedback, goal setting, and incentives enhance productivity and the practical manuals for implementing these interventions should facilitate the use of these techniques throughout the Air Force.

**Title:** Non-Appropriated Fund Supervisory Appraisal Form of Employee Performance

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**Description:** A modified non-appropriated fund (NAF) supervisory appraisal form has been developed to evaluate NAF employees throughout the Air Force. The primary purpose of the modification was to align the current form with the requirements of the 1978 Uniform Guidelines for Employee Selection. Revised appraisal elements were developed through subject-matter specialist selection, field input, and judgment analysis (policy capturing) of a promotion panel.

**Utilization:** The revised form, developed to meet the requirements of the Uniform Guidelines for Employee Selection, will minimize the threat of litigation and provide objective ratings that can be used to promote, remove, counsel, and reward NAF employees.

## FORCE MANAGEMENT SYSTEM



AFHRL Assesses On-the-Job Mechanical Aptitude

**Title:** Evaluation of Individual Performance in Mechanical Specialties

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**Description:** With a limited labor supply, the optimal utilization of all Air Force personnel becomes increasingly important. The ability to assess objectively and accurately an individual's level of performance on the job is critical to many areas of human resource management. The mechanical career area is a vital part of the Air Force and requires a high degree of mechanical competence as measured by the mechanical aptitude portion of the Armed Services Vocational Aptitude Battery. An effort is underway to develop an integrated performance assessment methodology applicable to all mechanical career fields. The methodology will consist of (a) a general framework of instruments and techniques, and (b) a set of clear-cut decision rules that can be applied to the content of each job. The methodology for constructing instruments and selecting instrument content has been developed. Performance assessment instruments and experience and interest questionnaires have been developed for the Tactical Aircraft Maintenance Career Field (431X1).

**Utilization:** The performance assessment system developed by this effort will be used to assess individual performance levels to evaluate the validity and efficiency of systems for personnel selection, assignment, training, and utilization. This methodology could provide a means for assessing the impact of policy, equipment, and training changes.

**Title:** A Process Model of Turnover Within an Open-System Context

**AFHRL Contact:** Thomas W. Watson  
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**Description:** This R&D effort involves a longitudinal assessment of the determinants of stay/leave decisions over time and takes process and open-system perspectives in examining this issue. The process perspective acknowledges that decisions to stay or leave evolve over time and that the relative weights of factors influencing such decisions change as members progress in their careers. The open-system perspective acknowledges that the Air Force is embedded in a larger context and that factors in the external environment, such as perceptions of desirable and obtainable alternative jobs, can have an impact on stay/leave decisions.

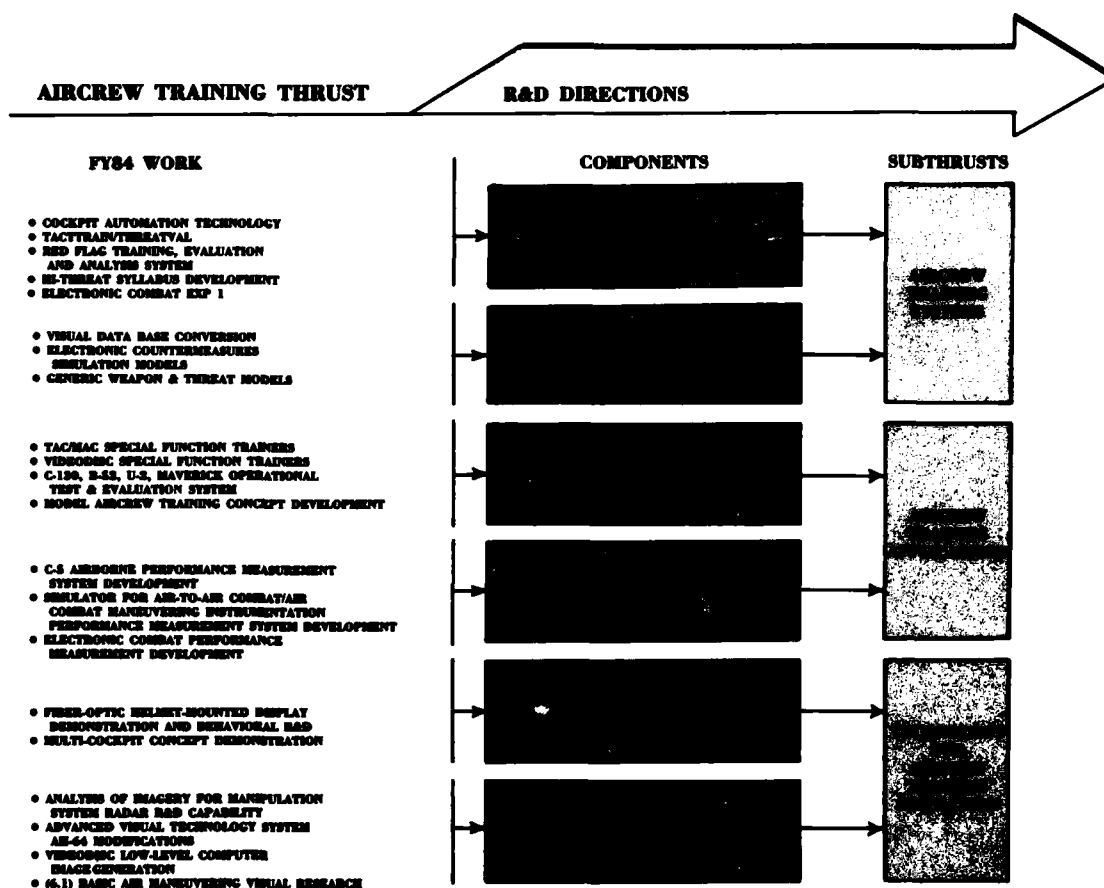
A hybrid model of personnel turnover serves as the conceptual foundation for this effort. This model integrates and expands upon existing models and is specifically tailored for Air Force use. It provides a coherent framework for examining a promising set of biodemographic, attitudinal, perceptual and economic variables which are likely to influence stay/leave decisions. A paper-and-pencil survey instrument has been developed and serves as the primary vehicle for data collection. However, data obtained from this source will be integrated with data from personnel files and other sources. The first of at least three separate administrations of the survey, occurring at approximately one-year intervals, is now underway and a sample of 7,666 first- and second-term enlisted personnel in eight occupational specialties have been mailed the initial survey. Responses will be analyzed to identify the most pressing determinants of stay/leave intentions and respondents will be tracked to monitor their actual stay/leave behavior. The adequacy of the model and the psychometric properties of the initial survey will also be assessed. This information will be used to refine the questionnaire for use in subsequent administrations.

**Utilization:** This R&D effort will be useful to Air Force researchers and managers by increasing their understanding of the factors influencing turnover decisions and their change over time. It will also enhance the ability of Air Force researchers and managers to predict turnover behavior before such behavior actually occurs, allowing remedial action to be taken to induce valued members to stay.



# AIRCREW TRAINING

# AIRCREW TRAINING THRUST



## AIRCREW TRAINING SYSTEMS

## TECHNICAL ACHIEVEMENTS

**Title:** Assessment of Workload and Prediction of Performance by Combined Psychophysiological and Behavioral Techniques

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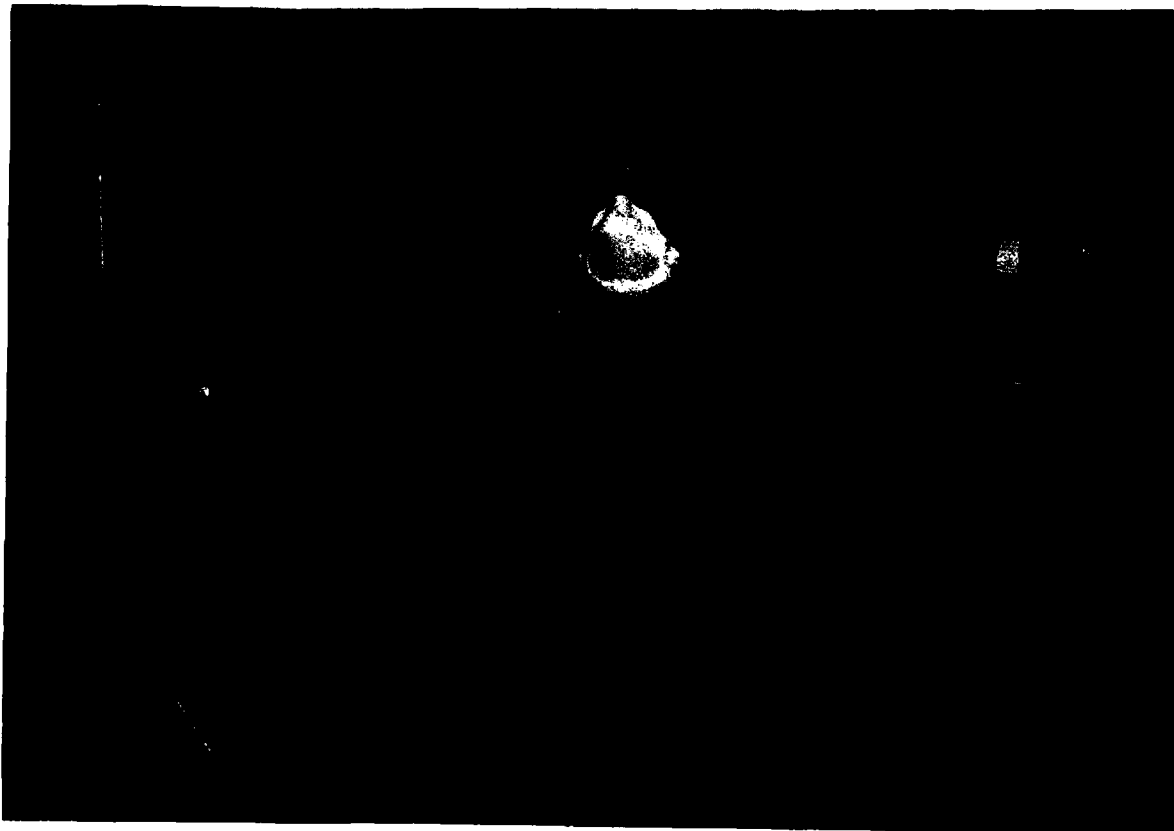
**Description:** The utility of multiple physiological indices of pilot attention and workload for flight simulator application was investigated. Such measures ultimately could be used in conjunction with other behavioral metrics of pilot attention and task difficulty to structure flight simulation training programs and equipment optimally. One initial objective was to establish laboratory facilities and procedures for processing the large quantities of data involved in

psychophysiological research and to ensure that all components of the psychophysiological recording system were functioning properly. A system was designed and fabricated to provide simultaneous recording of heart rate, skin conductance, respiration rate, cortical evoked response potential (ERP), and eye movement on the Advanced Simulator for Pilot Training.

A second major objective of this effort was to investigate the relationships among these variables and performance on information processing tasks. A simplified laboratory flight simulation provided the behavioral task used to study the various physiological variables. Heart rate, skin conductance, and respiration rate were studied as indices of autonomic arousal. Cortical ERPs, related to the complexity of the stimulus environment and associated processing requirements, were simultaneously recorded. This R&D effort was co-monitored by the Air Force Human Resources Laboratory and the USAF School of Aerospace Medicine, Aerospace Medical Division.

**Utilisation:** The autonomic measures (heart rate, skin conductance, respiration rate) reflected grossly the effectiveness with which the simulator scenario elicited an arousal response in the pilot subjects. Both the early and late components of the cortical EPRs varied with task difficulty and performance. The results showed that heart rate was a more reliable autonomic indicant of workload than was skin conductance and that three out of the four major evoked response potentials were related to workload. The ERP showed significant power in predicting level of simulator performance. These results would suggest that psychophysiological measures may be usefully employed to structure simulator training sequences to elicit optimum levels of stress and workload.

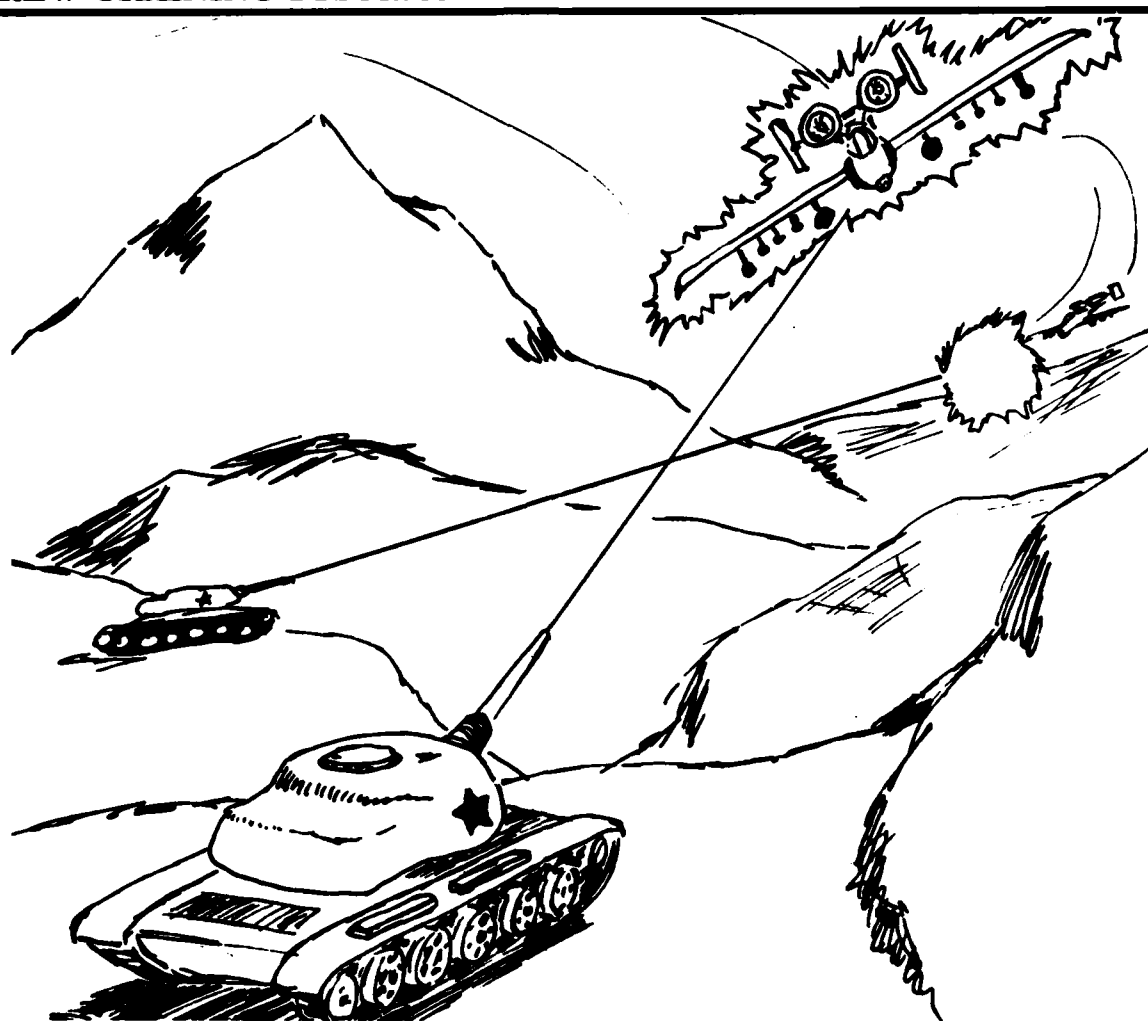
**Benefits:** Assessment of human performance has become more difficult as the complexity of man-machine systems has increased. The point has been reached where behavioral R&D must step beyond the limits imposed by quantifying behavior only in terms of motor responses. Psychophysiological assessment of the operator shows promise as a useful tool for this purpose. By combining behavioral and psychophysiological assessments, a more comprehensive profile of human performance should emerge. This should permit a greater understanding of the conditions under which performance deteriorates and should point to training techniques and training equipment configurations that will maximize pilot performance.



Psychophysiological Recording System



## AIRCREW TRAINING SYSTEMS



**Title:** Directed Energy (Laser) Flash Effects Study

Laser Effects Simulation

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**Description:** Mission-qualified A-10 aircraft pilots took part in a project to estimate the effects of directed energy (laser) threats to A-10 close-air-support (CAS) mission effectiveness. This project was a joint effort by AFHRL and the Letterman Army Institute of Research. The effort focused on the potential threat to aircrew survivability as well as the effects on both offensive and defensive aspects of the CAS mission associated with temporary loss of visual cues, that might result from the laser "flash effect". Utilizing the Advanced Simulator for Pilot Training (ASPT) the laser flash effect was functionally simulated by blanking out the out-of-cockpit visual scene for periods

of 6 seconds. In addition, the heads-up display was blanked and all in-cockpit instruments were frozen. The work did not address energy levels required for such an effect, foveal or parafoveal locus of exposure or the results of possible delayed effects (e.g., scotomas). Personnel from the Air Force Materials Laboratory involved in the development of eye protection devices for A-10 and F-16 aircrews as well as personnel from the Laser Laboratory at the Air Force School of Aerospace Medicine were briefed on the results of this study. Future studies on laser effects using the ASPT will (a) use an actual light source to simulate a laser, (b) investigate a range of flash effect durations, (c) incorporate an eye tracker for accurate line-of-sight information, and (d) be conducted within the context of the Low Altitude Navigation Terrain Infrared Night F-16 attack mission.

**Utilisation:** The results of this work and future follow-on R&D will have significant implications for

the training of pilots for tactical operations during periods of partial or total loss of customary in-cockpit and out-of-cockpit visual cues. Secondly, this R&D will have important implications for the LANTIRN attack mission. Lastly, the issue of effective aircraft control in the temporary absence of visual cues is important for the future use of automation in cockpit design.

**Benefits:** The ASPT with its current ability to conduct real-time, man-in-the-loop simulations of high-threat environments, is providing a critical R&D resource not only to the Air Force, but also to those segments of DoD where data collected on the ASPT can have far-reaching implications for the effectiveness of all DoD forces, ground-based as well as airborne.

**Title: Low-Altitude Database Development Evaluation and Research**

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**Description:** The low-altitude database development evaluation and research (LADDER) investigated the effects of alternative visual cue displays on pilot performance in a simulated low-level flight task. Two flight tasks were factorially combined with four surface texture and five vertical object conditions to provide 40 test cue conditions to the pilot in the form of a continuous flight course. The conditions were as follows: (a) task: steep and shallow turns, (b) surface texture: none, 150-foot square, 300-foot square, 450-foot square pattern, and (c) vertical objects: none, houses, storage buildings, trees, and combination of types spaced 1500 feet apart. In addition to the 40 test conditions, there were 16 replicates combining to provide a 420-mile course containing 56 sections. The course was 3000 feet wide, containing ridges and hills with mountains bordering the sides. The task was to fly through the course at 480 knots at 100 feet above ground level without the aid of altitude instruments. The visual display was provided by the F-111B color digital image-generation visual system and three associated wide-angle windows. The flight simulation was provided by the Advanced Simulator for Pilot

Training F-16 aircraft configuration flight dynamics in a T-38 aircraft cockpit with a static, pressure sensitive, centerline stick. Eighteen experienced fighter pilots served as subjects. The results indicated that both surface texture and vertical objects influenced flight control. The effect of surface texture was not a simple monotonic function of pattern size but interacted with object type. The mixture object condition was superior to the other conditions. Absence of texture and objects resulted in a higher rate of terrain collisions and a higher level of reported pilot discomfort than did any of the other conditions.

**Utilization:** The results of this project were used to make recommendations to the Tactical and Strategic Air Commands regarding the use of their operational visual systems for low-altitude database development and training.

**Benefits:** These results combined with those of previous ongoing AFHRL/OT efforts in visual displays for low-altitude flight will be used to formulate the design specifications for future systems.

**Title: Field-of-View Requirements for Selected Air-to-Air and Air-to-Ground Maneuvers**

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**Description:** The Tactical Air Command required parameters for the most efficient, fixed, limited-field-of-view (FOV) visual system for future operational flight simulators. Consequently, the FOV required to perform seven air-to-air and seven air-to-ground maneuvers was measured, and the effect of limiting the FOV for the air-to-ground maneuvers was evaluated.

The air-to-air maneuvers were performed in the Simulator for Air-to-Air Combat at Luke AFB, and included the Lo Yo-Yo, Hi Yo-Yo, Immelman Attack, Lag Roll, Lead Turn, Barrel Roll Attack, and Quarter Plane. The air-to-ground maneuvers were performed in the Advanced Simulator for Pilot Training at Williams AFB, and included level bombing; 10°, 15°, 30°, and 45° dive bombing; and 15° and 30° pop-up

## AIRCREW TRAINING SYSTEMS

bomb deliveries. In addition to measuring the FOV used with full-FOV conditions, required FOV for air-to-ground tasks was also plotted with a  $150^\circ \times 160^\circ$  limited aperture, representing a system being considered for procurement. Maximum required FOV was measured by plotting the target position in the pilot's FOV throughout the performance of each maneuver. Differences in performance in air-to-ground maneuvers were also evaluated between the full- and limited-FOV conditions.

**Utilization:** As the amount of visual information presented in a flight simulator display is increased, so are the costs. Therefore, the training payoff of the amount of visual data required must be clearly defined. The results of this effort will be used in defining the visual FOV required in future tactical flight simulators.

**Benefits:** This effort will help determine the most optimum balance of cost and training capability with no appreciable degradation in performance.

## ONGOING R&D

**Title:** Preliminary Investigation of LANTIRN Field-of-View on Pilot Performance

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**Description:** The Advanced Simulator for Pilot Training (ASPT) in the F-16 aircraft cockpit configuration will be used in this project. The ASPT/F-16 will simulate the field-of-view (FOV) that will be provided in the Low-Altitude Navigation and Targeting Infrared Night (LANTIRN) heads-up-display (HUD) system. Three modes of operation will be simulated: (a) normal, (b) look into turn, and (c) snap look. These FOVs will be presented on the ASPT visual system using a computer-controlled FOV mask. The existing F-16 HUD will provide the pilot with flight information. The visual database will be a simulated high-threat, deep-strike scenario used in previous studies. Initial studies will document the effects of the LANTIRN FOV on selected aspects of the mission (navigation, target acquisition, weapons delivery, and threat avoidance). Subsequent studies will investigate the potential of alternative training strategies (e.g., gradual reduction of FOV) on the acquisition of skills necessary for the LANTIRN environment.

**Utilization:** The results of these studies will be used to develop the LANTIRN simulator training syllabus and to define key parameters for further investigation in the workload and combat-training research areas of the LANTIRN training R&D program.

**Title:** Threat Engagement Assessment System

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**Description:** This R&D will investigate the potential training effectiveness of a computer-based graphics debriefing system within the context of the Advanced Simulator for Pilot Training (ASPT) simulated electronic warfare environment. Aircrews will fly a simulated combat mission in the ASPT and then be debriefed on the results of the mission just flown, providing immediate feedback of events which occurred. The effectiveness of the debriefing displays will be assessed in terms of the impact on subsequent performance in the flight simulator. Display characteristics to be evaluated include color, viewpoint, and availability for (or lack of) flight cues. Future improvements to this system will allow the pilot to refly the mission using a joystick to evaluate alternate mission plans.

**Utilization:** This system is found to enhance training effectiveness and will be used to debrief aircrews, providing immediate feedback on what happened during a simulated combat mission. This capability will allow pilots the opportunity to learn from their mistakes, thereby enhancing their survivability in combat. Analysts will be able to use this system to better quantify the outcome of simulated combat missions.

**Title:** Transfer of Training and Retention Study on Simulated Combat Training Using Electronic Countermeasures (Green Flag Exercise)

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**Description:** Mission-qualified A-10 aircraft pilots will be trained in close-air-support missions under high threat conditions in the Advanced Simulator for Pilot Training (ASPT). Special attention will be given to exposing the pilots to the electronic countermeasures being used in the 1984 Green Flag exercise at Nellis AFB. Operating within a full field-of-view, monochromatic, computer-generated visual system, pilots will visually engage multiple arrays of tank-type targets defended by surface-to-air missile and antiaircraft artillery threat systems. Pilots will be able to practice the use of defensive maneuvering, as well

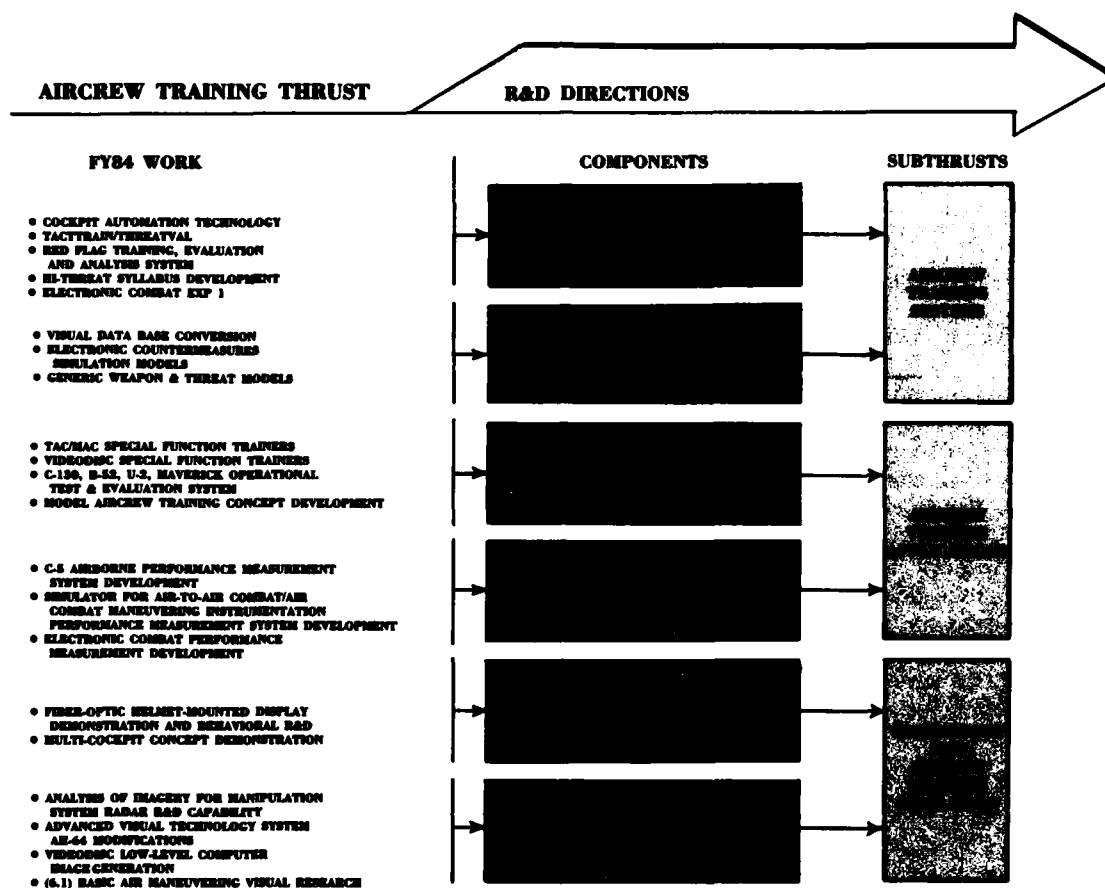
as chaff, against the fully interactive threat. Two groups of mission-qualified A-10 pilots will serve as subjects in this study. One group will function as a control group and will not receive any simulator training. The experimental group will receive initial training in the ASPT/A-10 electronic combat scenario approximately four months prior to participating in an actual Green Flag exercise. This group will return to the ASPT enroute to Green Flag for a skill retention test. Subsequent to the retention test, the group will receive additional ASPT training to regain initial training performance levels. The performance of both groups at Green Flag will be monitored and will serve as the basis for evaluation of the degree of transfer.

**Utilization:** This effort is designed to replicate the previous results in transfer of training from the simulator to an operational simulated combat exercise and to provide retention data. These data are necessary in order to specify the amount and spacing of training required to maintain mission-ready status.



Simulated Combat Environments are  
Used in Pilot Training

# AIRCREW TRAINING APPLICATIONS



## ONGOING R&D

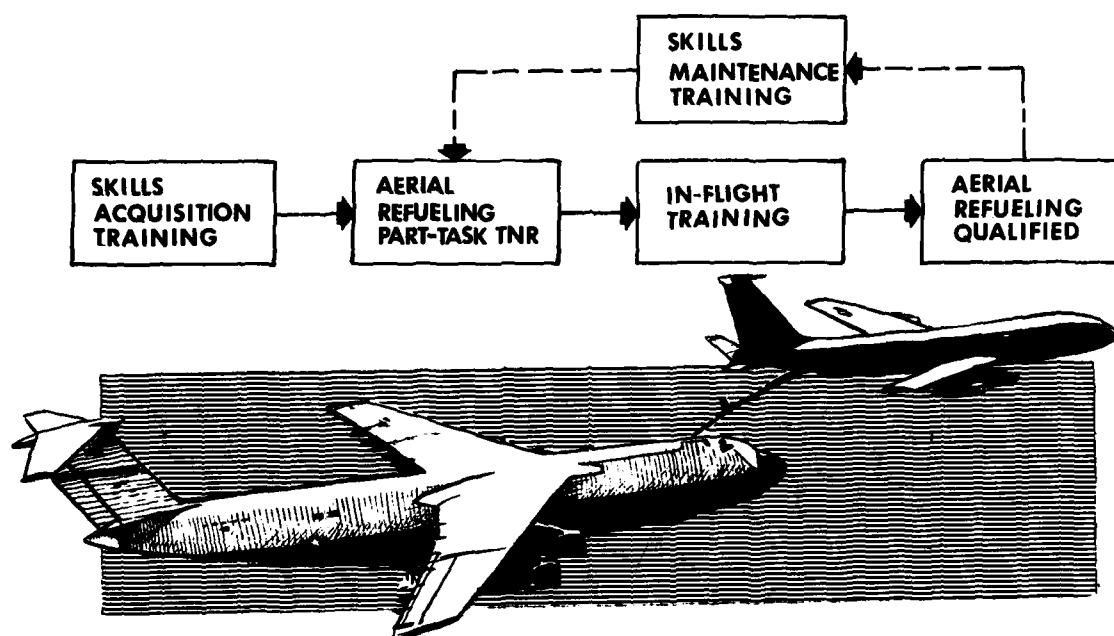
### **Title:** Aerial Refueling Part-Task Trainer Skills Acquisition and Maintenance Program

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**Description:** The primary objective of this project is to develop and evaluate programs for training C-5A and C-141B aircraft pilots and copilots in aerial refueling (AR) tasks using ground-based part-task trainers. The program will identify requirements for continuation training of AR rated pilots (skills maintenance) and initial training. A secondary objective is to provide data to unit commanders in order to facilitate effective allocation of AR training sorties

in maintaining aircrew proficiency. Training procedures and criterion performance levels will be identified using professional judgement and Instructional Systems Development procedures. Experimental training programs will be evaluated and modifications made based on trainee feedback and comparisons of in-flight performance among trainees receiving ground-based AR part-task training, trainees receiving standard AR training, and aircrews who are AR qualified.

**Utilisation:** The Military Airlift Command is currently under contract to procure a number of AR part-task trainers. The first of these devices will be delivered in FY86. The results of this effort will be used to provide MAC with recommendations for the integration and use of these devices in initial and continuation AR training programs.



## ARPTT PROGRAM CONCEPT

**Title:** Aircrew Training Management Information System

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**Description:** The objective of this effort is to develop and evaluate a microcomputer-based Aircrew Training Management Information System (ATMIS) for the Tactical Air Command. Unlike many previous R&D efforts that were concerned with the development and validation of aircrew performance measures, the present effort is concerned with the management and use of those measures for training purposes. ATMIS will be implemented in three phases over the next 2 fiscal years. Phase I comprises a review of training management information system requirements, a detailed front-end analysis of the selected aircrew

training program (the F-15 B-course conducted by the 405 Tactical Training Wing, Luke AFB), and prototype design, development, and demonstration. During subsequent phases, the ATMIS will be implemented at a selected training wing for a trial period. Pending a successful evaluation, a plan for command-wide implementation will be developed.

**Utilization:** The purpose of this effort is to use the existing TAC microcomputer capability to document, process, and provide summary reports of the data obtained on each student pilot during F-15 training. The data include mission/mission element grades awarded during simulator and aircraft sorties, weapons data obtained from analyses of gun camera records, academic scores, and the results of mandatory proficiency checks. By documenting TAC training, ATMIS will provide information to help TAC aircrew personnel improve their combat capability and also to help TAC training managers identify aircrew training requirements and develop optimal training programs.

## AIRCREW TRAINING APPLICATIONS



Pilot Using the Electronic  
Countermeasures Part-Task Trainer

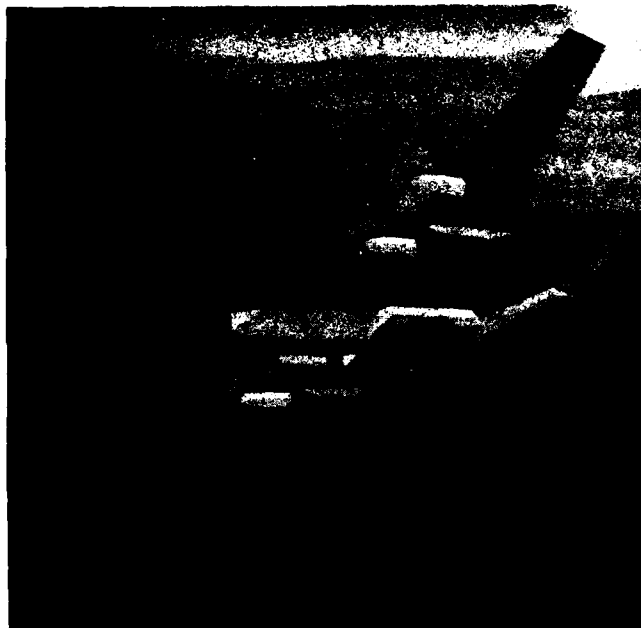
**Title:** Radar Warning Receiver/Electronic  
Countermeasures Part-Task Trainer

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**Description:** In response to a need for training in the Tactical Air Command electronic combat (EC) skills, the Operations Training Division of AFHRL initiated training R&D on a radar warning receiver (RWR) and electronic countermeasures (ECM) part-task trainer (PTT). The objective of this R&D was to utilize and evaluate existing microcomputer technology for part-task training in electronic combat conducted in TAC schools and operational units. There are two specific parts to this objective: (a) to develop a PTT based on this technology to effect large-scale training cost avoidance and (b) to provide demonstrations of applied PTT designs for EC training and provide empirical validation of training effectiveness.

A color graphic representation of the RWR scope and indicator control panel is presented on a Microangelo Color Graphic system. The algorithms necessary to simulate the RWR/ECM system have been developed. The appropriate audio signals accompanying the graphic display of the RWR are presented through the use of an S-100 soundboard. The student interacts with the graphic display through the use of a touch-sensitive panel. A complete interactive text and test are available as selectable menu options. The text and test are designed so that the student can review as much or as little material as desired. Over 20 different malfunctions of each RWR system can be reviewed.

**Utilization:** The product developed in support of this R&D includes RWR and ECM simulation systems for six TAC aircraft, for a total of 25 different systems. The software generating the simulation is compatible with the computers TAC purchased for use in the operational squadrons; thus, the cost of the PTTs will be extremely low. Reduced training time/costs will be realized through enhanced efficiency of EC training. The ultimate results will provide TAC with a low-cost, training-effective EC PTT that will enhance aircrew survivability.



Pilot Training via Computer Imaging

**Title: Model Aircrew Training System**

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**Description:** The Model Aircrew Training System (MATS) will apply advanced training development, delivery, evaluation and management concepts to aircrew training in a program that incorporates all phases of instruction ranging from initial entry through continuation training. AFHRL will develop this program in conjunction with the Military Airlift Command for application to the C-130 weapon system. The planned training system will be capable of tailoring training to the needs of individuals through innovative management and utilization of available training resources, employing proficiency-based instruction and advancement. The major components of MATS will be: (1) the training curriculum to include learning objectives, performance standards, evaluation procedures, media selection, syllabi, and quality control procedures and, (2) a computer-based support system to provide for training program development, instructional delivery, evaluation of crew performance, and management of all training resources.

**Utilization:** Application of advanced training technology and practices should produce improved delivery capabilities and more effective training, resulting in expanded training capacity and improved aircrew performance. Integrating all phases of training into this model system should eliminate gaps and overlaps that currently exist, especially between formal schools and operational units. MATS would provide for effective use of existing resources and training media, especially the full exploitation of combat training capabilities of the C-130 weapon system trainer. This training system will serve as a prototype that will provide opportunities both to illustrate and to evaluate advanced training technology applications. Generalization is expected to extend to C-5 and C-141 aircrew training as well as to SAC and TAC aircrew training programs.

**Title: Performance Measurement Requirements for Tactical Aircrew Training**

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**Description:** This effort will identify the requirements for a comprehensive aircrew performance measurement system necessary for the efficient conduct, management, and evaluation of Tactical Air Command training programs for the F-15, F-16, and A-10 aircraft. All media will be considered within the context of how they are used in all phases of training. To accomplish these objectives, R&D will (a) define TAC's needs for measurement information in terms of both the "user" and "intended use" of such information, (b) develop evaluation criteria for assessing the adequacy of the measurement information, (c) document existing TAC measurement techniques, (d) identify deficiencies in these techniques, (e) identify areas where state-of-the-art technology might be applied, and (f) identify areas where further R&D is necessary.

**Utilisation:** The product of this effort will be a plan for improved quantification of combat capability resulting from training in aircraft, academics, and ground-based devices.



## AIRCREW TRAINING APPLICATIONS

**Title:** Integrated Simulator/Airborne Performance Measurement System for C-5A Aircraft

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**Description:** Because of escalating flying costs, there is a critical need to achieve maximum training value from Air Force simulators. One problem resulting from this objective is to determine the relationship of aircrew performance in the simulator to subsequent performance in the actual aircraft. A project has been initiated to solve this problem by developing an integrated aircrew measurement system for use on the ground and in the air. The goal is to develop a computer-based system that will generate objective indices of performance in either the simulator or the aircraft. A prototype system is currently being developed using the C-5A aircraft and flight simulator as the test vehicles. The approach has been, first, to develop a measurement capability for the flight simulator, followed by an extension to the aircraft. The system under development acquires data directly from the flight simulator through several interfaces. It uses its own computational capacity to generate the objective measures of aircrew performance. For the aircraft, objective flight data will be acquired from the C-5A maintenance data recording systems. Using a ground-based computer system, the same set of objective performance measures can be calculated. To date, the simulator measurement system has been completed and successfully integrated with one of the C-5A flight simulators at Altus AFB. During FY83, test and evaluation of the simulator measurement system was initiated and is currently being used in support of the copilot training course at Altus AFB. The design study for the airborne phase of the project is in progress and should be completed during FY84.

**Utilization:** The C-5A performance measurement system (PMS) will provide the Military Airlift Command with the means for quantitatively assessing the effectiveness of C-5A aircrew training. As a prototype, the system will aid in the functional specification for future simulators and aircraft. In operational terms, the C-5A PMS will enable the objective measurement of many relatively tedious and mundane tasks such as

checklists, procedures, navigational profiles, and maintaining prescribed flight parameters. This will enable the instructor/examiner to concentrate efforts on higher order skills such as crew coordination and resource management. The PMS can also be used extensively in the simulator training programs, since it has the capability to generate predefined mission scenarios automatically. In this context, the C-5A PMS can provide an important quality control function in that it will become the basis for the more efficient management analysis of training programs. The potential exists for the PMS to provide far better and more uniform quality of training program graduates, far lower "unit" production costs, and increased production rates.



Pilot's Aircraft Performance Being Measured

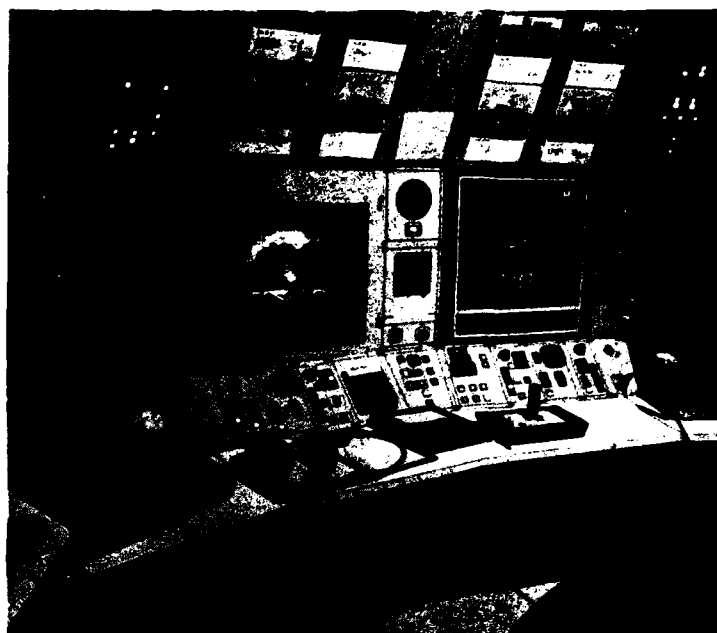
**Title:** Air Combat Measurement System for the Simulator for Air-to-Air Combat and the Air Combat Maneuvering Instrumentation

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**Description:** The specific problem addressed in this R&D is the lack of a performance measurement system for the Simulator for Air-to-Air Combat (SAAC) and the Air Combat Maneuvering Instrumentation (ACMI).

The SAAC is the only USAF simulator used for close air-to-air combat training. The ACMI, on the other hand, enables the monitoring of airborne engagements. Unfortunately, neither of these devices has an air combat measurement capability. During FY83, a project was completed that refined the all-aspect maneuvering index (AAMI), an air combat measurement technique originally developed for the US Navy. This effort developed a design specification for a prototype measurement system that could be integrated with both the SAAC and ACMI. During FY84, development of the prototype system will be initiated. The air combat measurement system will have the following capabilities: (a) real-time monitoring, recording, and scoring of air combat data from the SAAC and ACMI, (b) implementation of the AAMI scoring technique, (c) real-time graphic feedback, (d) hard-copy debriefing reports, (e) graphic replay for debriefing, (f) data storage and analysis, and (g) growth provisions for the development and testing of alternative scoring procedures and graphic display formats. To implement these capabilities, a stand-alone computational system will sample data from the SAAC and ACMI, thereby enabling development and testing without interfering with ongoing training operations.

**Utilization:** The air combat maneuvering performance measurement system will provide the Tactical Air Command with the means for quantitatively assessing mission readiness and evaluating the effectiveness of its air combat training programs. It will provide mission feedback, thus improving the effectiveness of available training resources. The system will also provide AFHRL with the needed measurement capability for the pursuit of air combat training R&D. At present, the lack of an objective means of assessing air combat maneuvering performance has prevented certain critical issues from being properly addressed. The development and validation of such objective measures would enable questions to be answered that could potentially impact the combat readiness of our forces. First, it would enable the precise definition of air combat training event requirements, and this would permit flying hour requirements to be based on aircrew proficiency needs rather than on best guesses. Second, it would provide the tools necessary for establishing simulator utilization requirements for initial skill acquisition as well as for continuation training.



Measurements of Pilot's Simulator Performance

**Title: C-130E Weapon System Trainer  
Operational Test and Evaluation**

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**Description:** The Military Airlift Command (MAC) procured ten C-130 instrument flight simulators (IFSs). These simulators provide high-fidelity replications of all C-130 aircraft crew stations (except loadmaster) and are used for both skill acquisition training and continuation training. One wide-field-of-view, full day/night, color, six-window, five-channel computer generated image visual system was added to the pilot production IFS to form the C-130E weapon system trainer (WST). AFHRL is supporting a MAC-managed, MAC-directed follow-on operational test and evaluation (FOT&E) of this WST. This FOT&E is being conducted to evaluate how this visual system impacts simulator training effectiveness at all levels of C-130 training. Tasks that involve substantial out-the-window visual cues were selected for training in the WST. Instructor and student evaluations of the WST for this training are being collected, and subsequent student in-flight performance is being

## AIRCREW TRAINING APPLICATIONS

monitored. For continuation training, attention is being focused on evaluating WST training for night vision goggles operations, low altitude parachute extraction system drops, selected emergency procedures, and combat operations.

**Utilisation:** The results of this FOT&E are impacting two areas. The first is a procurement decision regarding visual systems for the remaining IFSs. Estimates of how the visual system impacts training effectiveness will enable an in-depth comparison of benefits and costs. The second area is how to use the devices most effectively for training. Utilization plans will likely drive visual system requirements for the remaining devices. Effective training programs in the WST are expected to allow substantial reallocation of in-flight training resources and to provide valuable training in areas where training is currently limited, particularly combat and special operations training. This FOT&E is allowing MAC to observe the impact of WST training on aircrew performance in flight, and is a critical part of the development of more effective programs. The WST represents a new level of technology that has only recently been available to the Air Force training community. The lessons learned in this FOT&E are being applied not only to C-130 training, but to other training programs where training devices with similar capabilities are being acquired.

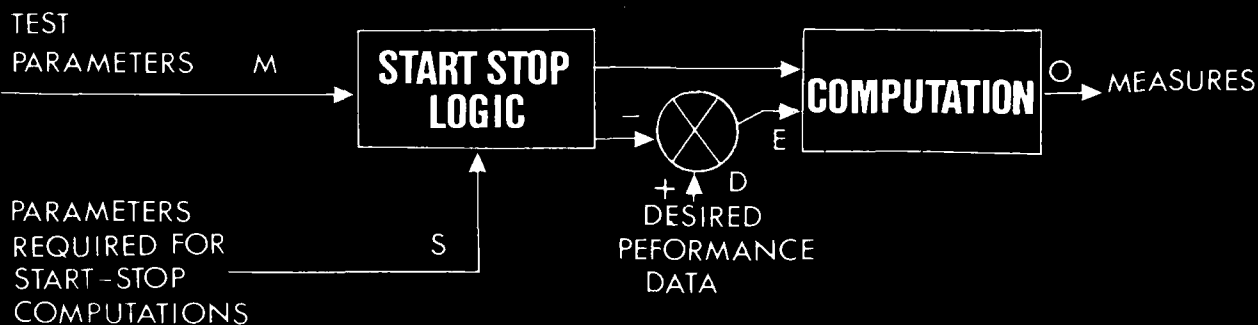


### **Title: Technology for Special Function Trainer Requirements**

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**Description:** The Military Airlift Command (MAC) has expressed intense interest in the use of low-cost microelectronics systems as a means of reducing training costs. Technologies such as microcomputer graphics systems coupled with state-of-the-art instructional methods appear to have significant training cost-avoidance potential. This R&D will assist in determining the value of inexpensive desk-top devices for training aircrews to perform selected cognitive elements which comprise many aircrew procedural tasks. AFHRL is providing technical assistance to MAC in the form of instructional design consultation, software review and critique, and conduct of field evaluations of several experimental systems. One of the systems is being developed to train C-141 and C-5 aircrews in the operation of a new fuel savings advisory system being retrofitted to these aircraft. Another system is being developed to train procedural and computational skills to C-130 loadmaster personnel. Software for other systems also may be developed and evaluated as part of this R&D. The design of these systems includes a user-friendliness feature, making the trainer easy to use and otherwise attractive to the trainee.

**Utilisation:** The cost avoidance potential of special function trainers (SFTs) is thought to be greatest during the early phases of training because of the power to effect relatively higher levels of skill earlier in programs. This should facilitate greater aircrew performance during advanced phases when tasks are integrated during rehearsal of full missions. Thus, SFTs are seen as reducing training time requirements in weapons systems trainers and other simulators. Assuming that MAC SFTs produce the expected positive training transfer ratios, other tasks with skill components similar to those incorporated in the experimental trainers also may warrant SFT development efforts. By extension, the concept of "software families" for varieties of tasks should prove feasible with the likelihood that the costs of these training innovations can be quickly recovered by large-scale distribution of SFTs across programs.



## IDENTIFICATION OF MEASUREMENT PARAMETERS

**Title:** Performance Measurement System Design Guidelines for Aircrew Training Devices

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AUTOVON 474-6561

**Description:** The objective of this effort is to develop a set of guidelines to aid in the specification of performance measurement system (PMS) requirements for future simulator acquisitions. At present, there exist no guidelines for specifying PMS requirements in any detail. Only the most rudimentary specifications are provided, and these generally amount to the monitoring of a specified set of parameters. Likewise, the manufacturer is usually in the position of not knowing what to provide since the requirements are so ill defined. The guidelines to be developed will address all aspects relating to the design, development, and incorporation of PMS capabilities within Aircrew Training Devices (ATDs). Since training requirements are generally on a task-by-task basis, a considerable portion of the guidelines will address measurement requirements at this level. Considerations to be addressed for each type of task will include (a) functional capabilities such as start/

stop logics, measures to be generated, display formats for immediate feedback, summary scores, and post mission debriefing formats, (b) software requirements such as parameters to be sampled, minimum sampling rates, unique sampling requirements, and (c) hardware implications such as memory size/speed, and interface requirements. Because such detailed information will not be available for the range of tasks to be considered, the guidelines will also address how to go about developing such unique capabilities.

Aside from considering PMS requirements at the task level, the guidelines will also address system level aspects. These will include such items as mission-generation capabilities, PMS control functions over the basic simulation, instructor interface/control requirements, and data storage and analysis requirements. In sum, the guidelines will primarily address the functional requirements for a PMS in ATDs and the resulting hardware and software implications.

**Utilization:** The primary user of such guidelines would be the Simulator Systems Program Office although secondary users would include the Major Commands, who often specify training device requirements, and the simulator manufacturers. The resulting guidelines will enable the precise definition of flight simulator measurement requirements and allow estimates of the required hardware/software to support implementation.



Pilot Using Generic Threat Recognition Trainer

**Title:** Generic Threat Recognition Trainer

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**Description:** The generic Threat Recognition Trainer provides the basic gaming elements of air-to-surface electronic combat in a compact desk-top system. The student pilot learns to identify and evade various enemy defenses while attempting to destroy ground targets. Variable terrain features, aircraft flight parameters, radar warning receiver (RWR), and electronic countermeasures effects are provided. The trainer is comprised of off-the-shelf commercial devices integrated with a computer. The combination of industry standard hardware and software allows easy implementation of add-on equipment and widely available high-level language processors. Major additions to the basic computer are a very flexible color graphics system and a joystick and throttle arrangement for analog inputs by the trainee. This arrangement, with its corresponding analog-to-digital interface,

allows the pilot to interact with the computer program on a real-time basis. Additional equipment includes the sound board that simulates the audio signals associated with the RWR. User-friendly menus have been designed to allow the trainee to have the following options: (a) view an intelligence briefing prior to a pass, (b) view the probability of kill graph of the last pass, (c) perform another pass, or (d) create a new environment. The trainer also has "freeze" and "abort" capabilities. The most outstanding characteristic of the generic Threat Recognition Trainer is that it is highly flexible. As requirements change, the system can be modified to accept new software and hardware to thus provide relevant training for many years.

**Utilization:** This system will provide affordable training in threat recognition and avoidance at the operational squadron level for Tactical Air Command personnel. This training will be applicable to numerous aircraft weapons systems and satisfies a training requirement that is largely unfulfilled at the present. Improved combat readiness and force multiplication through increased weapons effectiveness and survivability in high-threat environments are anticipated.

**Title: Electronic Combat Range Training Effectiveness**

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**Description:** The objectives of this R&D are to develop measures of electronic combat (EC) performance and to use them to evaluate the effectiveness of current EC training. In order to accomplish the objectives, a three-phase R&D effort is proposed. The requirements for Tactical Air Command (TAC) and Strategic Air Command (SAC) differ somewhat, and those differences are noted in the outline of the three phases:

1. In Phase I, Review of R&D and of Measurement Capabilities, R&D in the areas of electronic combat, EC training, performance measurement, and other relevant information have been reviewed. This material has been assembled and is being utilized in Phases II and III.

2. In Phase II, Development of Methodology for Measuring Training Effectiveness, measures identified in Phase I are being refined and validated in conjunction with the assessment of the impact of certain training factors.

In support of TAC, the effects of variables such as threat density, feedback, and training frequency are being tested on-site in the Advanced Simulator for Pilot Training. Transfer of training within the simulator environment (i.e., from a restricted training environment to a combat exercise environment) will provide an evaluation of the utility of various factors. In support of SAC, the issue of simulator training effectiveness is being addressed via the B-52 Weapon System Trainer. Measures of electronic warfare officer performance have already been identified and validated.

3. In Phase III, Evaluation of an Integrated Program for EC Training for Selected Missions/Systems, the problems of integrating ground, simulator, and in-flight training to provide an optimal mixture will be addressed. Based on the results of Phase II and inputs from operational sources, an integrated training program will be developed and evaluated for certain missions/systems.

**Utilisation:** The accomplishment of this training R&D will produce (a) a validated set of measures for evaluating EC performance, (b) a methodology for assessing the training effectiveness/utility of EC training concepts, (c) an evaluation of the training effectiveness/utility of various EC training options, and (d) recommendations for an optimal arrangement of training schedules and systems with regard to type and frequency. For SAC and TAC, this R&D will define presently unknown requirements for EC training, establish necessary levels of operator proficiency, and provide estimates of EC effectiveness.

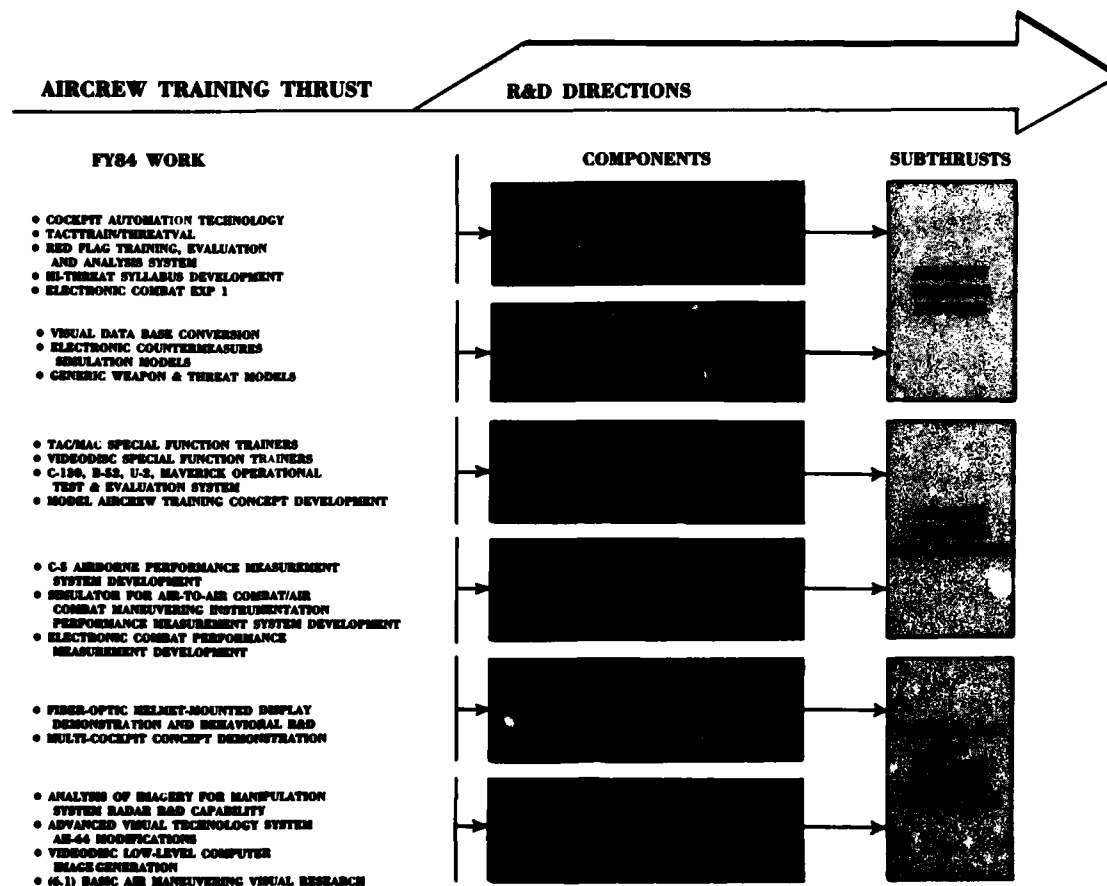
**Title: Aircrew Training Task Surveys**

**AFHRL Contact:** Bernell J. Edwards  
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**Description:** Recent interest in microcomputer-based trainers on the part of potential users has prompted AFHRL to initiate a series of surveys of aircrew training tasks. This effort will provide a required database for systematically assessing the cost-avoidance potential of emerging, advanced technology part-task training devices to support aircrew training within the operational commands. Surveys are in progress within the commands to determine the perceived effectiveness of current training for the various tasks performed by aircrews. Data will be used to analyze and prioritize training tasks and otherwise assess the appropriateness and potential effectiveness of new special-function trainer (SFT) technologies for supporting the training of specific tasks. Aircrews are being asked to rate adequacy of training, training difficulty, and available training media relative to the tasks they perform. Surveys are in progress within the Military Airlift Command and are in planning for the Strategic Air Command. Surveys are being planned for the Tactical Air Command.

**Utilisation:** As a required formative step toward the systematic development of SFT technology, survey data will enable AFHRL to identify, classify, and prioritize task elements and commonalities across various missions and aircraft. This will facilitate the identification of those areas of training that can most logically benefit from applied SFT technology. Planned R&D growing out of the survey data includes the development and evaluation of several generic prototype SFTs with sufficient software flexibility to impact a relatively wide range of training requirements. Data from the prototype R&D, combined with that from other experimental SFTs, will culminate in the development of a handbook of guidelines for operational aircrew users of SFTs.

# TECHNOLOGY FOR AIRCREW TRAINING SIMULATION



## TECHNICAL ACHIEVEMENTS

### Title: Comparison of Some Flight Simulator Visual Displays

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**Description:** Data collection has been completed to determine if there are performance differences among pilots accomplishing simulated aerial refueling using five different visual display configurations. All the displays were used in the A-10 cockpit of the Advanced Simulator for Pilot Training (ASPT). The configurations were (a) a helmet-mounted stereoscopic display with a 40° field of view (FOV), (b) a helmet-mounted biocular display with a 40° FOV, (c) the full ASPT 300° FOV, (d) the ASPT visual display masked

to present a 40° FOV, and (e) PLZT goggles (stereoscopic) using one ASPT window. This R&D was carried out to gain insight to the relative merits of the various display systems. For instance, is stereopsis associated with performance superior to that of other displays? Do optics directly in front of the eyes interfere with performance? Is wide FOV important? Is PLZT technology superior to helmet-mounted stereoscopic displays? Forty subjects participated in this experiment--eight per display condition.

**Utilisation:** Data analysis is not complete; however, preliminary indications are surprising. None of the dependent measures appear to differ significantly among the five display conditions. It is particularly surprising that stereoscopic presentations do not appear to aid the performance of tasks whose critical visual cues are only a few feet from the pilot. Moreover, it is not expected that the computer statistical analysis, now in progress, will show any significant differences.



Stereoscopic Goggles

**Title:** Low Altitude Navigation Targeting  
Infrared Night System

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**Description:** F-16 and A-10 aircraft cockpit simulators are being developed for the Low-Altitude Navigation Targeting Infrared Night (LANTIRN) attack system. The LANTIRN simulators will have a full-field-of-view visual display, along with radar and infrared (IR) sensors. The databases for each of these image types will simulate combat environments, including planimetric and cultural details, threats, and sensor-related environmental effects. The radar and IR databases are being generated by a B-52 weapon systems trainer. These data will be transferred to the LANTIRN simulator through a fiber-optics link. The LANTIRN system will provide a full-mission trainer for all aircraft systems and weapons delivery. Weapons will include bombs, a 20mm cannon, and Maverick missiles.

**Utilization:** AFHRL personnel working with The Tactical Air Command will design a training syllabus to teach pilots how to operate systems peculiar to the

LANTIRN aircraft and how to use this new equipment to fly a low-level mission effectively at night. The AFHRL simulator will be the only device that TAC will have available for LANTIRN training for approximately 2 years. The LANTIRN simulators at AFHRL will provide TAC with a training capability that would be otherwise unavailable. Training R&D will commence in the important area of sensor-based night attack. Pilots will be able to fly their missions with a higher degree of safety and greater precision. The LANTIRN simulators will also provide AFHRL with a research capability in the areas of low-level flight, sensors, and pilot workloads.



F-16 with LANTIRN Pods on Low-Level  
Under Weather Mission



## TECHNOLOGY FOR AIRCREW TRAINING SIMULATION



Breadboard Fiber-Optic Helmet Mounted Display

**Title:** Fiber-Optic Helmet-Mounted Display

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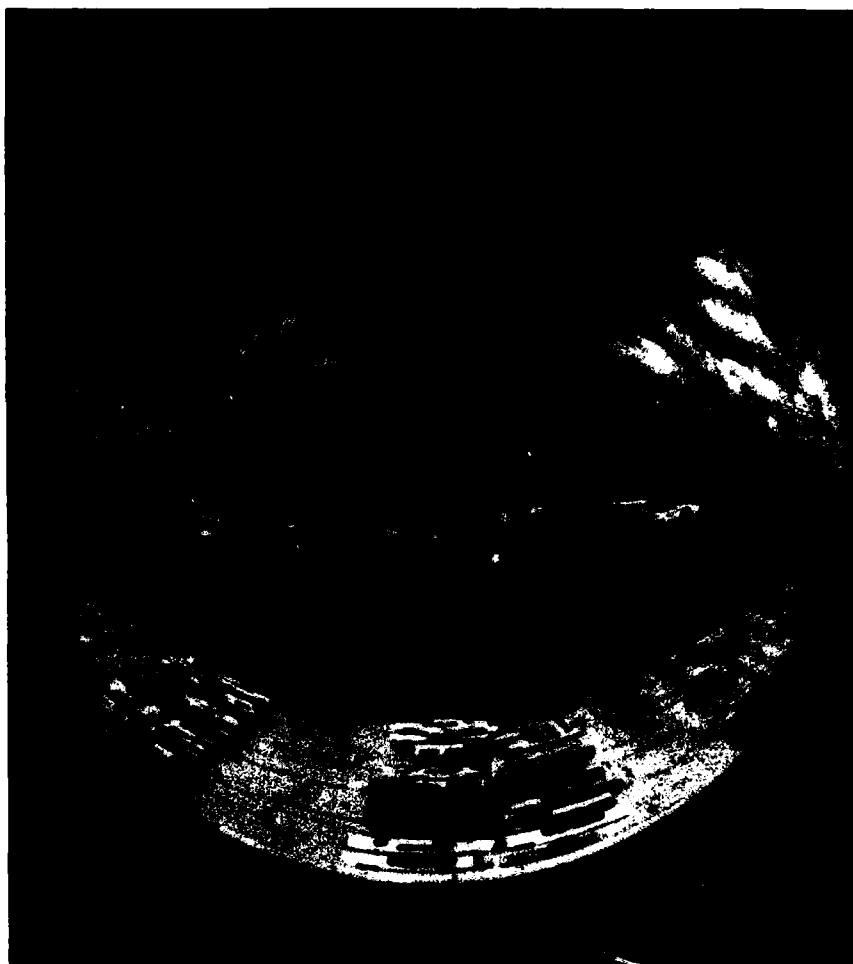
**Description:** The fiber-optic helmet-mounted display (FOHMD) program is currently the only DoD-sponsored display system that can provide the color, high-brightness, high-resolution, and wide-field-of-view display required for tactical air-to-air and air-to-ground training R&D in a timely (FY84) and affordable manner. This system uses coherent fiber-optic bundles to pipe imagery from high-brightness color projectors to a helmet display. The initial breadboard Phase I system uses two 15x15mm bundles and two 8x10mm bundles. It has a large head-slaved background area with a central high-resolution inset that can be configured to either 25° or 40°. An optical steering system is used to compensate for computer image generator transport delays of up to 100 msec.

An off-line eye tracking system is being used to collect eye movement data. Phase I performance parameters are:

Brightness	- 80 foot-lamberts (color)
Resolution	- 2 arc minutes high resolution - 6 arc minutes peripheral field
Field-of-View	- Unrestricted (135° X 60° instantaneous)

The Phase II refinement effort will allow a reduction from four to two bundles, as well as a reduction in the size of those bundles. Dynamic multiplexing will be used to decrease the effects of the fiber structure. An optical head-tracking system providing high dynamic accuracy will also be incorporated.

**Utilization:** The performance of the FOHMD will provide a previously unavailable capability to train both air-to-ground and air-to-air maneuvers in a full-field-of-view flight simulator. Unlike current conventional displays, this system can fully display the capabilities of state-of-the-art image generators and could be used in conjunction with the advanced visual technology system. The FOHMD will provide a significant breakthrough in display technology.



Properly Distorted Input Image  
to the Variable Acuity Lens

**Title: Variable Acuity Projector**

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**Description:** If full support of human vision were attempted through typical flight simulation methods, 1 minute of arc resolution would be necessary over a 180° field-of-view. Since the necessary bandwidth of 1000 MHz is not practical, either resolution or field of view is usually compromised or an area-of-interest high-resolution inset is employed. The variable acuity system presents an alternate solution providing high resolution and wide fields-of-view without increased bandwidth/computational requirements or the need for

additional projectors and optics for high-resolution insets. The concept is based on the fact that only 130,000 picture elements (pixels) are required to fully support human vision. The eye achieves its resolution by a nonlinear distribution of pixels, with highest concentration at the center of vision. A display presented to the viewer using the 130,000 pixels in the proper nonlinear distribution would present an eye-matched display. In the above scene, the variable acuity lens would rectify the image by compressing the pixel displays near the center of the scene and expanding the pixel densities at the periphery, resulting in high detail near the center at the expense of peripheral detail.

**Utilisation:** A variable acuity display system could provide an alternative transportable visual display system. Generation of the entire visual field could be accomplished with a single video channel rather than several. In conjunction with a head-tracking device, 160° field-of-view would require no more projection capability than would a single conventional 525-line display.

**Title: Visual Database Generation Management**

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**Description:** As visual systems for flight simulators produce more scene detail, more and larger databases will be required. The limiting factor for a visual environment to become operational is the time required for development. Four projects are currently underway to develop alternate methods of data base management: (a) a database conversion system, which will convert databases formatted for one visual system to the format required for another visual system, (b) an interactive database management system, which will

## TECHNOLOGY FOR AIRCREW TRAINING SIMULATION

allow modelers to easily and quickly generate, modify, test, and document databases without using a real-time simulator system, (c) an automatic method of generating databases from photographs, to significantly speed up the generation of cultural and terrain models, e.g., tanks, aircraft, buildings, and mountains, and (d) a library of standard digitized models of various military vehicles and aircraft for continual update/expansion.

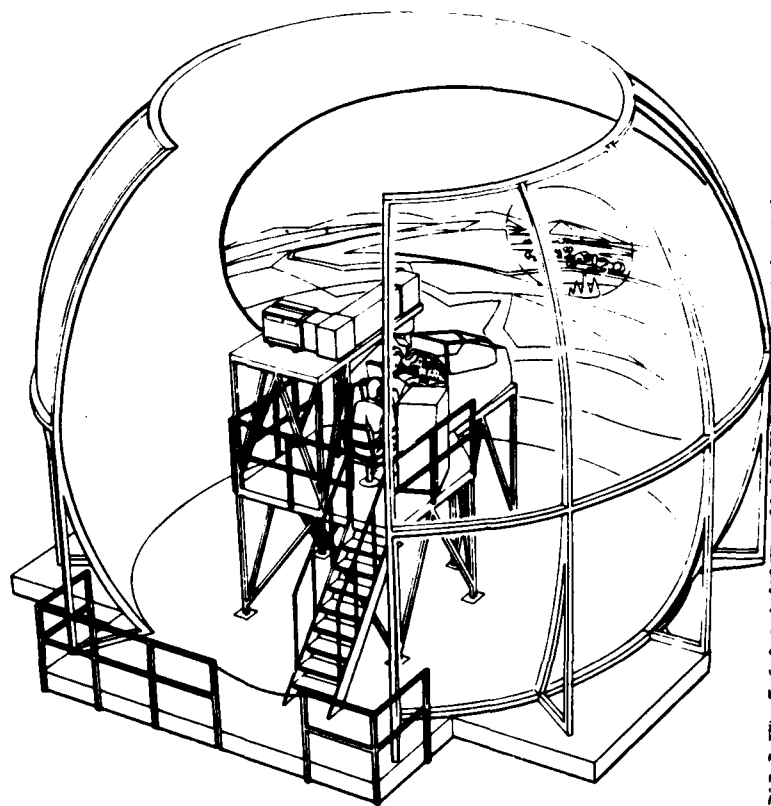
**Utilization:** An interactive modeling system will be user friendly and database independent. The database library will allow modelers to generate visual environments more efficiently. All of these efforts will decrease the time required for development of visual environments.

**Title:** Fresnel Lens Applications to Flight Simulator Visual Display Systems

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**Description:** Flight simulation visual systems employ a variety of display technologies. The most generally useful device is the cathode ray tube which suffers from the deficiency of limited light outputs. This deficiency is compounded in many simulator applications by the need for collimating optical systems that result in light loss of up to 99%. This effort will develop a lightweight virtual image display system consisting of collimating plastic Fresnel lenses that should enable light transmission of 75% rather than the current typical light transmission of 1%. This effort will complete an optical design of a Fresnel lens for use on visual displays. An evaluation model will be constructed and tested. Subsequent phases will correct any deficiencies identified in the evaluation model.

**Utilization:** High-brightness infinity or virtual image displays are required in simulated scenes presented to trainees to achieve maximum realism in training. This effort will develop a compact virtual image device that converts a real image into a virtual image such that the scene appears to be at real-world distances (collimation) with minimum loss of brightness.



Dome Display of Advanced  
Visual Technology System

**Title:** Advanced Visual Technology System

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**Description:** The computer image generator (CIG) being developed under The Advanced Visual Technology System (AVTS) project is designed to provide visual "out-the-window" imagery for the full spectrum of tactical air missions. This includes air-to-surface weapons delivery, low-level flight, acquisition of surface-to-air missiles, and evasive maneuvers. Air-to-air combat is simulated, providing options of 1 vs. 1, 2 vs. 1, and 2 vs. 2. Normal flight operations such as takeoff, landings, and aerial refueling can be performed.

The CIG will be compatible with different types of display systems, including the F-16 seven-window dodecahedron and the new 30-foot AH-64 helicopter dome. It will provide high quality, very realistic imagery for combat simulation. A new contractor development, called "cell texturing" will allow for greater scene detail. It offers significant improvement over conventional texture and results in near-photographic quality fully interactive computer-generated imagery.

Another part of the advanced visual technology system (AVTS) is the Visual System Component Development Program (VSCDP). This is an Army-funded visual R&D program that will lead to a production contract for a visual system for the AH-64 helicopter. The AFHRL CIG will be modified to increase its capabilities and to make it compatible with new display systems. Modifications will include:

1. A multiple-viewpoint capability will be added to permit the system to portray multiple-ship combat engagements for tactics research and evaluation.
2. The capability for distortion correction will be added to allow the CIG to be used with displays other than mosaic cathode ray tubes.
3. Four of 10 channels will be modified with state-of-the-art technology to provide real-time cell-texturing capability. This feature provides realistic, high-detail imagery for low-level flight.
4. An infrared sensor capability will be added to two channels of the CIG. This will enable the CIG to be used both for combat mission training and development of the Low Altitude Navigation Tactical Infrared Night attack system.

The program also includes the development of a wide-field-of-view dome color display. This system will use optical inset blending and eye/head tracking to provide a high resolution, high-quality display image.

**Utilization:** The new CIG will be a powerful tool for determining training effectiveness in a wide-field-of-view simulator. Integration of the dome display and the modified CIG will create an advanced display system capable of training such tasks as air-to-ground combat and nap-of-the-earth flight.



Computer-Generated Imagery of  
Advanced Visual Technology System

**Title:** Analysis of Imagery for Manipulation

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**Description:** New high-resolution radars currently being integrated into such aircraft as the F-15, F-16, and B-1B pose a serious problem for radar simulation because of their increased ground resolution capability. To help determine the ground resolution and image fidelity requirements for the simulation of such radars, the Analysis of Imagery for Manipulation program will selectively alter the characteristics of both actual and simulated radar imagery through the use of digital image processing technology. Examples of the image variables that will be manipulated in this program include range resolution, field-of-view, and the number of internal edges presented. Performance assessments and transfer-of-training studies will be conducted with various levels of this imagery to identify critical image requirements.

**Utilization:** The results of this effort will be used to help define the image fidelity required for future radar simulation systems.

## TECHNOLOGY FOR AIRCREW TRAINING SIMULATION

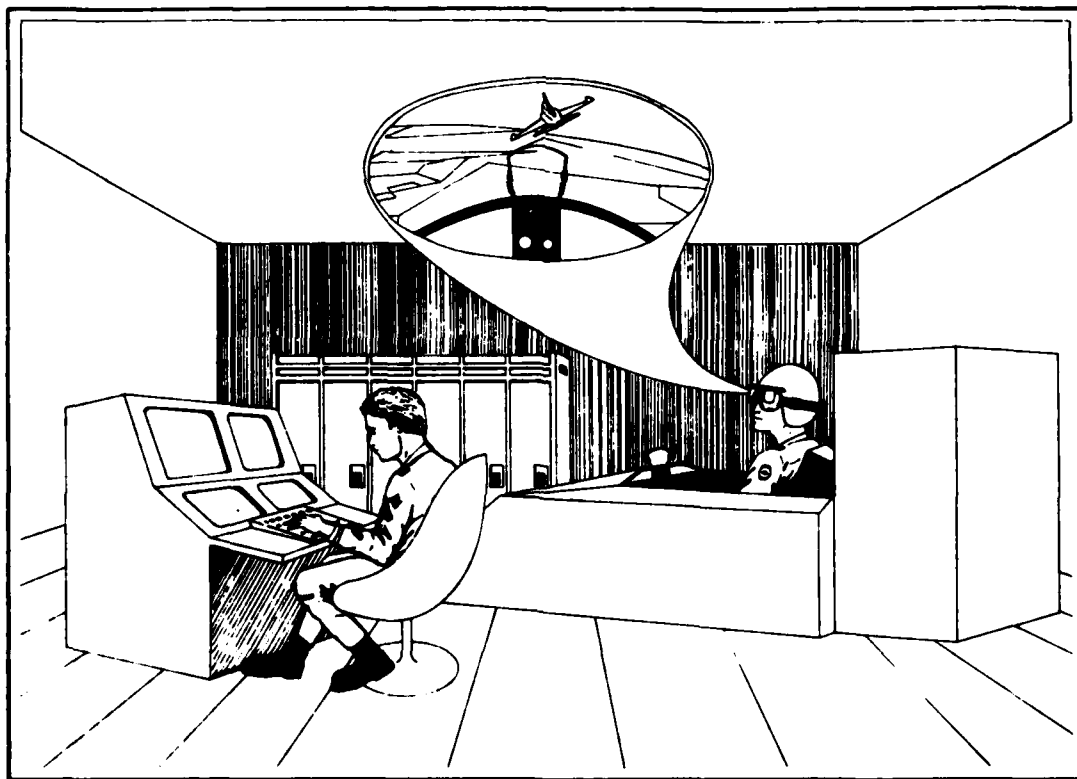
### **Title:** Combat Mission Trainer

**AFHRL Contact:** Lt Col Peter A. Cook  
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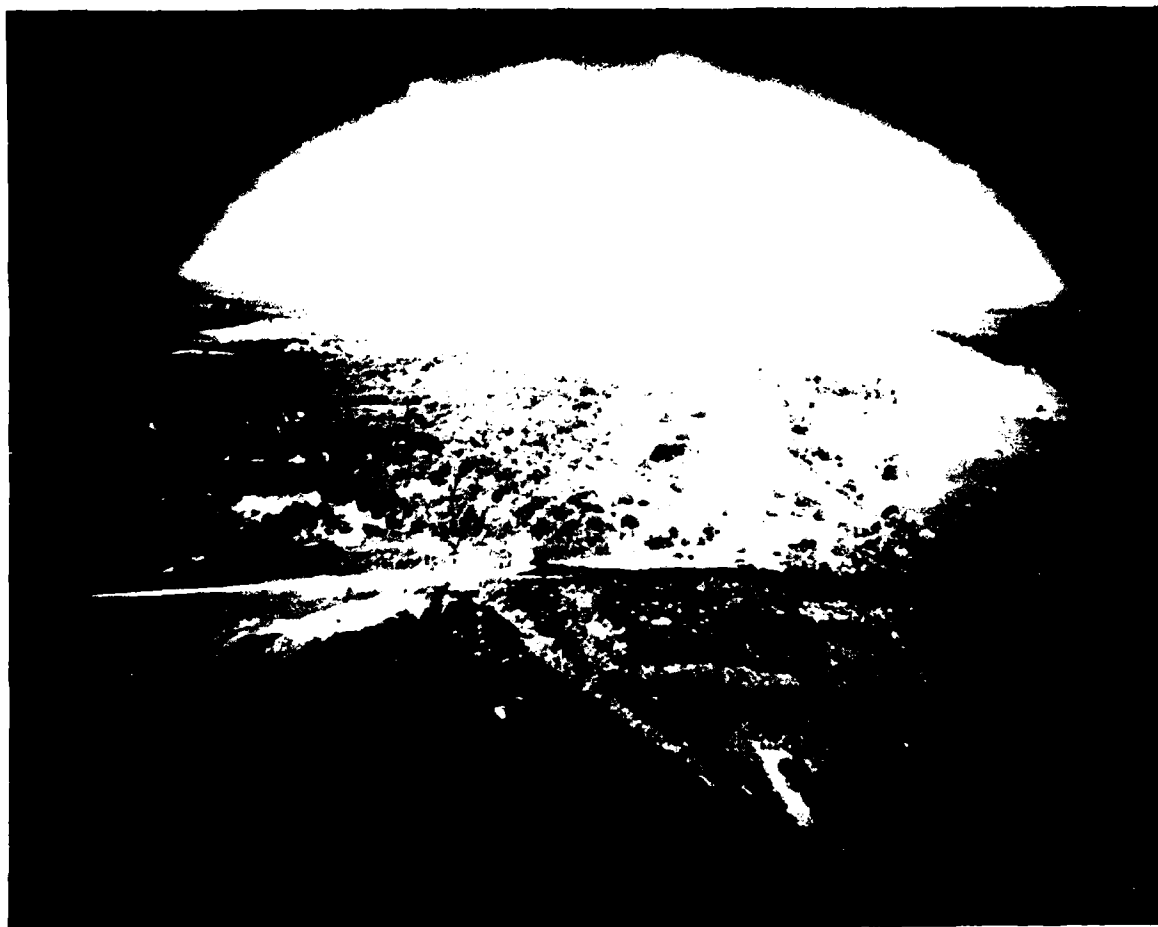
**Description:** The objective of the Combat Mission Trainer (CMT) program is to enhance aircrew performance in the multiple-aircraft, multiple-threat environment by developing key simulation technologies to provide effective training for combat-essential tasks at minimum cost. The CMT will integrate new display technology with advances in the microprocessor, sensor, and communications fields. This program will ultimately develop a multi-user, multi-sensor, full-mission demonstration system that will support the

design concept of widespread simulated combat mission training. Several key components must be developed and integrated before the CMT concept can become reality. Most challenging has been the development of a high-resolution, small-size display. Advanced development of supporting systems such as fighter cockpit, instructor/operator station, and computational and linkage systems will also represent major cost and size reductions necessary to support the program objectives.

**Utilisation:** The affordability and modularity of a final CMT will provide the opportunity to train combat mission skills at the unit level. Frequent simulated practice of realistic combat tasks will maintain individual combat skills at "razor's edge" proficiency. This will serve as a significant force multiplier through increased targets destroyed and enhanced survivability.



Combat Mission Trainer--Artist's Conception



Videodisc-Based Display of Real World Tactical Environment

**Title:** Videodisc Technology Applications to Full Mission Visual Display Systems

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**Description:** This effort is investigating the extension of a contractor-developed Videodisc Visual System technology to fighter combat training requirements. The objective is to validate, by non-real-time emulation, the concepts developed under the study phase for providing a low-level, high-speed display. Low-altitude photographs have been taken of potential routes in which to emulate the feasibility of the separate region mapping concept to low-level, high-speed visual simulation. A segment including imagery of a bridge

and tree lines was selected for real-time emulation. Techniques with which to incorporate moving ground targets into the videodisc scenes have been developed. The system will also be designed so that a variable acuity lens can be used to project an eye-matched dome display.

**Utilization:** The successful development and integration of this technology could represent a major breakthrough in visual simulation. The nonprocessing intensive nature of the system would allow a major advance in terms of visual scene detail, texture, and realism compared to the computation-bound approach in totally computer-generated imagery systems. The terrain textural fidelity capability inherent in this approach may finally provide realistic simulation of real-world tactical environments. Especially notable is the potential for simulation of realistic missions requiring low-level navigation for threat avoidance.

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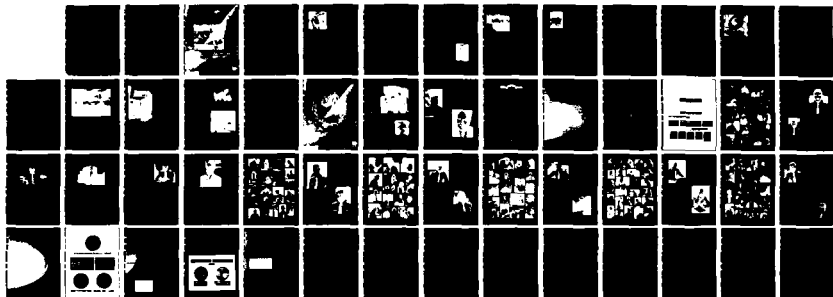
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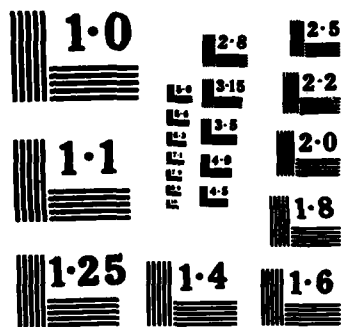
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***"To be prepared for war is one of the most effectual means of preserving peace."***

***George Washington***

***"Eternal vigilance is the price of liberty."***

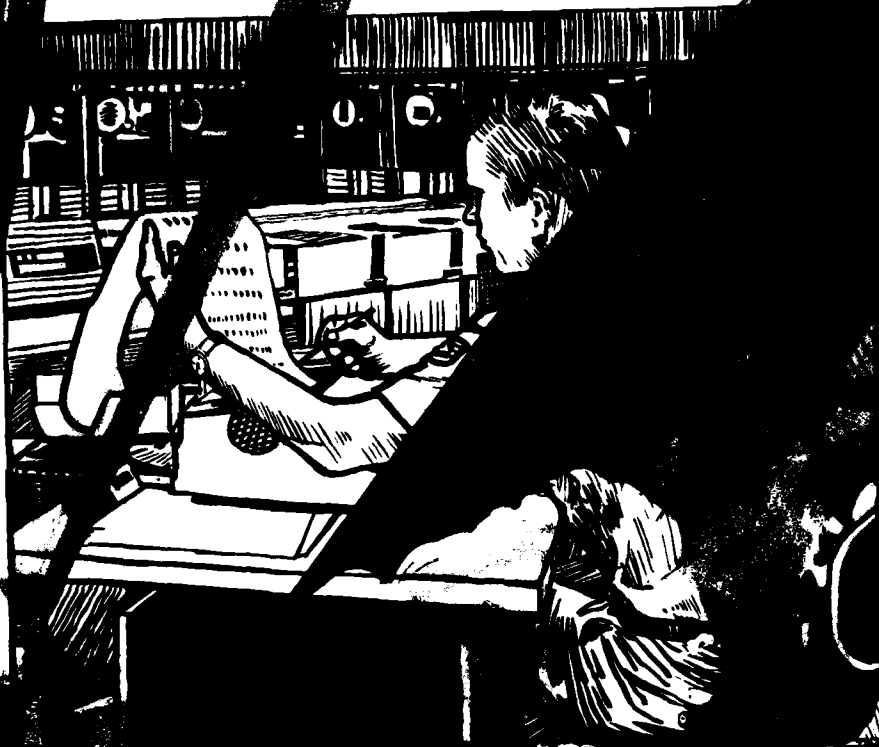
***Thomas Jefferson***

***"Throughout America's adventure in free government, our basic purposes have been to keep the peace; to foster progress in human achievement, and to enhance liberty, dignity and integrity among people and among nations."***

***Dwight D. Eisenhower***

***"Our military forces are back on their feet and standing tall once again, young Americans wear their uniforms and serve their flag with pride."***

***President Ronald Reagan***



**TECHNICAL  
SUPPORT**

## TECHNICAL SUPPORT

**Title:** Technical Support of Comprehensive Occupational Data Analysis Programs

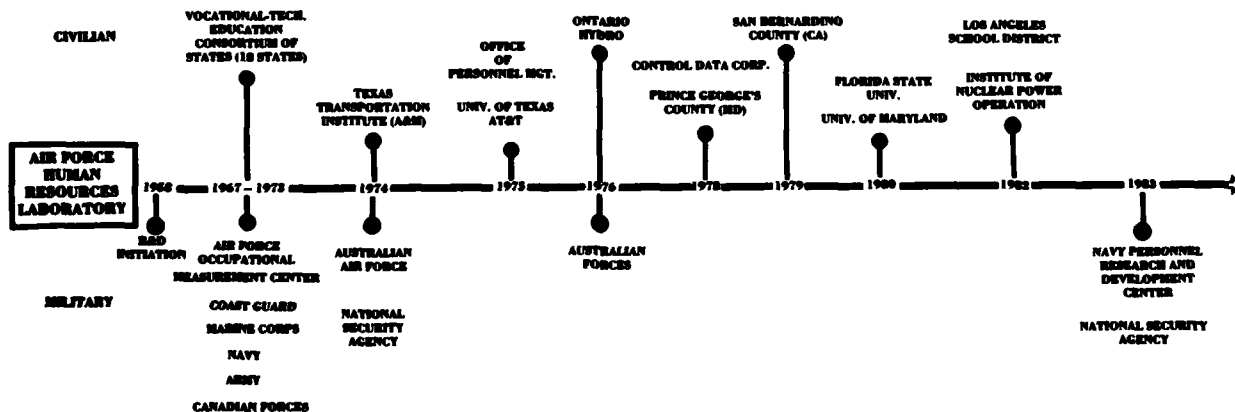
**AFHRL Contact:** Janice Buchhorn  
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AUTOVON 240-3928

**Description:** The Comprehensive Occupational Data Analysis Programs (CODAP) system was developed to provide an efficient and effective method of identifying and classifying jobs in a rapidly changing Air Force environment. The Technical Services Division of AFHRL develops, maintains, documents and provides consultation in the use of the CODAP system by data-processing personnel at the Laboratory and at the USAF Occupational Measurement Center. The basic input to the system is information provided by a large number of supervisors and job incumbents in the occupational area being studied. Because the data are collected at the worker-task level, CODAP provides a base of information that can be viewed in many ways and then used to address unanticipated management questions

whenever they arise. The purpose of the technical programming support is to improve the operational efficiency of the programs and to develop interactive terminal routines that relieve most of the less critical activities associated with setting up computer runs.

**Utilisation:** In addition to the operational uses of CODAP in developing and validating the content of training programs, it is being used to address questions about the requirements of jobs that will be integrated with the initial personnel selection process and eventually with the person-job match model. Although CODAP was developed by the Air Force, all branches of the Department of Defense, as well as the British, Canadian, and Australian military forces, have incorporated this system into their operational programs. Many state and county governments are also beginning to use CODAP to validate their traditional testing and selection procedures and, at the same time, to develop performance evaluation criteria. Educational institutions are using CODAP to modify the curricula of their vocational education programs.

### TECHNOLOGY TRANSFER OF CODAP





**AFHRL Conducts Follow-up Studies  
of AFROTC Selection**

**Title:** Follow-up on Air Force Reserve Officer Training Corps Graduates with Scores of 20 and Below on the Officer Quality Composite of the Air Force Officer Qualifying Test

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**Description:** In the fall of 1971, Air Force Reserve Officer Training Corps (AFROTC) was authorized to begin enrolling applicants for the advanced program without regard to the individual's score on the Officer Quality Composite (OQC) test. Prior to this approval, cadets were required to score 25 or higher on the OQC for admission to the program. After approval, applicants were selected by use of the multiple factor selection system (MFSS). This system involves a whole-person concept in which all available information about the applicant is considered along with the OQC score which, though still a factor, is no longer a single eliminating element. Comparisons of 320 AFROTC graduates commissioned in FY74 under the MFSS and a comparative sample of 960 non-MFSS AFROTC graduates commissioned in FY74 have been made each fiscal year from 1976 through 1981 to study the long-term similarities/differences in undergraduate pilot training, undergraduate navigator training, technical training, officer effectiveness report ratings, and

continuation in the Air Force. To provide data through the time period that allows the completion of 6-year active duty service commitments, an analysis of the data collected and updated through FY81 is being provided. A final study showing trends across the 6-year period is being considered.

**Utilization:** The results of this long-term effort will be used by AFROTC to assess the impact of MFSS graduates on the active duty force in terms of continuation in the Air Force, and success/non-success in pilot, navigator, and technical training courses.

**Title:** General-Purpose Program Development

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**Description:** The Technical Services Division of AFHRL develops, maintains, documents, and provides training in the use of general-purpose computer software. This software includes the broad categories of (a) language translators, such as pre-compilers and interpreters, (b) utility programs, such as sort/merge and report writers, (c) applications programs such as correlation/regression analysis and multidimensional frequency distributions, and (d) subroutine libraries containing common computing algorithms. The Technical Services Division is responsible for more than 460 general-purpose and statistical analysis programs and over 2,845 pages of user guides to those programs. Benefits to AFHRL derived from the development of general-purpose programs include (a) reduction in the number of unique occurrences of a computing algorithm thus decreasing the possibility for error, (b) increasing individual programmer productivity by reducing the number of special purpose programs written and audited, (c) standardization of products to reduce analysis time by researchers, and (d) a concentration of program maintenance and enhancement activities into a group specialized in the production of efficient computer software. AFHRL acquired the author system for education and training (ASET) to provide computer-assisted instruction to personnel using the Univac 1100/81 computer system. New ASET courseware is being developed to teach the use of in-house software systems.

## TECHNICAL SUPPORT

**Utilisation:** General-purpose software supports virtually all Univac 1100/81 data processing activities related to AFHRL R&D programs as well as the computational support to other agencies such as the Air Force Manpower and Personnel Center and the USAF Occupational Measurement Center. One such program, PRISM, was designed as a high-level utility programming language specifically for the development of interactive programs with complete control of all Univac 1100/81 facilities and file types. PRISM was used to create several new software products such as (a) The basic attribute test (BAT) tape conversion system for analysis and reduction of data collected from the Laboratory's Experimental Test Facility, (b) a series of interactive editors specialized for COBOL data files, print files and symbolic layouts, (c) an interactive documentation retrieval system for locating, reviewing and printing user guides to AFHRL software, (d) an interface to the new large-volume sort facility which provides both a concise command language and an interactive question-and-answer setup for less experienced personnel, and (e) a comprehensive system for generating, converting, and reporting frequency distributions.

### **Title:** File Item Data Organizer

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**Description:** The file item data organizer (FIDO) database containing selected data elements from Air Force Manual (AFM) 300-4, Volume 3, Data Elements System, was designed, developed, documented and is being kept current by the Technical Services Division. FIDO evolved from the need of R&D efforts involving present and longitudinal sample selection where codes contained in the AFHRL-unique database had to be identified and interpreted by research scientists. A major FIDO application is the preparation of file edits. In such an application, a microfiche report is prepared which contains both the frequency and English language meaning for each code value within each data element of a file. Use of on-the-shelf file edits can effectively direct the research planner's attention to potential problem areas in construction of working samples from master files. FIDO also contains an automated inquiry/retrieval system vital for the establishment of databases for personnel research projects and probe analysis to determine the feasibility of proposed major R&D efforts involving databases.

FIDO is on-line on the AFHRL Univac 1100/81 computer system. It consists of 751 Air Force and DoD defined data elements used in Air Force automated personnel data systems; examples are security classification, grade, Air Force specialty code, and major academic field. The update procedures now in use are to be improved so they will provide more accurate and timely data. Also, procedures are to be developed to get this information directly from the database being developed by the Air Force Data Systems Design Center. The update procedures are now supplied to AFHRL periodically by magnetic tape. The file item data organizer II (FIDO2) has been implemented. This system keeps a history of the data use identifiers found in AFM 300-4 and gives the user access to it from its first entry in AFM 300-4.

**Utilisation:** FIDO directly supports virtually all facets of personnel and manpower R&D conducted by AFHRL. Many R&D efforts involve longitudinal studies of specific samples cutting across many different data files and code values over varied time periods. Automated availability of Air Force- and DoD-defined data elements, as well as other nonstandard data elements, with their data values and meanings across time when combined with heavy usage by programmers/analysts, represents a sizable savings in work hours. These hours would otherwise be spent in researching hundreds of manuals and/or microfiche by hand in order that the needed code be properly identified for a given historical time period.

As FIDO is implemented, scientists may, on retrieval, specify all code values in effect dating back to the establishment of a given data element or may specify inclusive dates and get only those codes in effect during the interval in question. The data can be displayed on a remote interactive terminal, or a hard copy may be requested showing title, data element name, definition/explanation, code values, effective dates, and explanation of code values. The Laboratory staff estimates the system is used 3,000 times per year. The times accessed represent the number of files for which FIDO definitions are obtained. On a large file, such as the Uniform Officer Record, distributions can be obtained for 1,954 data elements. A conservative estimate is that an average of 50 data elements are researched each time the FIDO system is accessed, for a total of 150,000 data elements per year.

## PERSONNEL RESEARCH DATABASES

## ● 3028 TAPE REELS:

- 2626 REELS (DATA FILES)
- 402 REELS (INTERIM PROCESSING)

## ● 851 DATA FILES:

% OF DATA FILES	RECORDS PER FILE
54	100,000
36	100,000-499,000
10	500,000-4.7 MILLION

**Title:** Human Resources Research Database

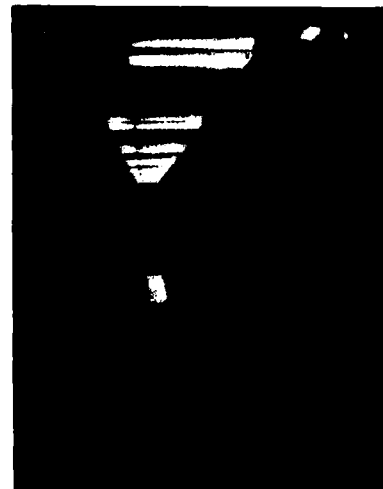
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**Description:** A series of databases containing information on personnel and training systems has been developed and updated with FY83 data. Software has been implemented to organize these data into readily accessible databases for support of R&D studies of the personnel system, to display selected information from a single database, and to consolidate information on a common subgroup from two or more databases. Procedures are established to receive automated personnel and training data generated separately in standard and command-unique data systems on officers and enlisted personnel. These reflect personal characteristics at time of entry, performance outcomes during flying or technical training, career status at periodic intervals, and information related to reenlistment or separation. Special files will be created to meet long-term study requirements and longitudinal files will be constructed to facilitate studies in career development. File management and information retrieval procedures have been developed and are maintained under Microform System 4B-73.

Plans are being developed to build database research systems for the collection, analysis, retrieval, and reporting of a wide variety of historical and current information describing the officer and airman forces. A dynamic database research system capable of providing responses from operational and research investigators will eliminate the requirements for the development of many small fragmented databases and greatly reduce the start-up time and cost of many personnel research efforts.

Major master personnel files are maintained historically on Air Force enlisted and officer personnel and include: enlisted strength file from 1964, officer strength file from 1960, officer effectiveness report file from 1955, airman reenlistment and loss file from 1955, airman entry file from 1955, technical training file from 1956, flying training file from 1964, and Air National Guard and Reserve files from 1970. These files are received from various Air Force agencies such as Air Force Manpower and Personnel Center, Air Training Command, Air University, and Air Reserve Personnel Center. Special longitudinal files, such as, the airman gain/loss and the officer gain/loss are developed in-house from these databases and significantly reduce data-processing requirements in many personnel and training R&D studies.

**Utilization:** The database represents a low-cost means of acquiring and maintaining information used in the development and validation of personnel selection and classification instruments, development of assignment procedures, derivation and revalidation of promotion systems, and special-purpose analyses to determine the long-range impact of specific personnel and training policies. The availability of these data makes it possible to carry out studies on numerous aspects of the personnel and training systems that would otherwise be infeasible. Extracts of these data are used in research projects by other Air Force organizations.



Air Force Personnel Data Bank  
1956 to Present

## TECHNICAL SUPPORT



**AFHRL Maintains Extensive Data Files  
on Enlisted Personnel**

**Title: Historical Database of Enlisted Personnel  
by Cohort Year Group**

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**Description:** The cohort database supports loss/reenlistment/extension analyses to identify requirements/trends by fiscal year of accession. This database is extracted from the airman gain/loss (AGL) master file and has been developed covering accessions and associated loss/reenlistment/extension transactions for a 10-year "moving window" period upon which reports are based. The AGL File is current through the first half of FY83. A system of programs to process all subsequent studies on the cohort database has been developed and will provide a more accurate and easy-to-follow audit trail. Statistical tables using this database are prepared annually. They reflect the (a) percentage of total lost (within each type of loss category), (b) percentage of loss from accessed population at the beginning of a year to cover a 10-year period, (c) cumulative percentage of loss, (d) percentage of those lost in Basic Military Training (BMT) by type-of-loss category, (e) percentage of those lost subsequent to BMT by type-of-loss category, (f) total percentage of extending population, (g) percentage

of beginning population who have extended and are on extension, (h) percentage reenlisting, (i) percentage reenlisting with/without bonus, (j) percentage reenlisting with less/more than 90 days to expiration of term of service, and (k) percentage of losses eligible/not eligible to reenlist. Statistical summary tables to provide quick reference to the number of individuals accessed in each fiscal year also show the (a) number lost, (b) loss rate, (c) retention rate, (d) continuation rate, (e) number reenlisted, and (f) reenlistment rate. These counts and percentages are reported for each of the 10 fiscal years covered by the report.

**Utilisation:** These reports are used to track enlisted retention by cohort year groups, relate enlisted retention/reenlistment losses to personnel program objectives, and analyze the retention/reenlistment/losses of cohort year groups by various demographic attributes, such as sex, race, academic education level, Armed Forces Qualification Test group category, term of enlistment, age at accession, number of dependents, and marital status. These reports are used by personnel systems managers at Air Force Headquarters, the military personnel system and the Office of the Secretary of Defense.

**Title: Air Force Personnel Survey Program**

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**Description:** The Technical Services Division of AFHRL provides optical scanning and computational support on the Univac 1100/81 computer system for Air Force personnel surveys approved by the Research and Measurement Division of the Air Force Manpower and Personnel Center. The data reduction and analyses of approximately 45 surveys during FY83 were accomplished by using general-purpose computer programs developed by the Technical Services Division. Pre-survey work includes sample selection and the preparation of self-adhering address labels. Also, on-site training is provided for the Air Force Manpower and Personnel Center programmers who are responsible for processing survey data.

**Utilisation:** Upon completion of each survey analysis, the raw data files are retained for use in Laboratory R&D programs. The survey products are used by Air Force managers at all levels.



Air Force Personnel Surveys  
Are Regularly Conducted

**Title:** Technical Training Graduation/  
Elimination Rates

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**Description:** Analyses of technical training graduation or elimination rates (a) provide personnel managers data to track elimination rates of enlisted personnel from basic resident technical training courses, (b) provide information on the characteristics of successful and unsuccessful students in basic resident technical training courses with regard to mental ability, aptitude, educational level, race, and sex, and (c) appraise the effects of the 4-year, 4-year guaranteed, 6-year, and 6-year guaranteed enlistment options on success rates in basic resident technical training courses. Summary reports are prepared quarterly for Air Force enlisted personnel who terminate technical training in each quarter of the fiscal year. Frequency counts and percentages are reported for each reason of termination of training, i.e., graduation, and academic and medical elimination. Frequency counts and percentages are also reported for average scores of the following Armed Services Vocational Aptitude Battery variables: Mechanical, Administrative, General, and Electronics tests and on the Armed Forces Qualification Test for each basic resident technical training course and selected special courses. All of these frequency counts and percentages are reported for each course by race, sex, race/sex combined, 4-year or 6-year enlistments, academic education level, and mental category.

**Utilization:** The reports are being used to focus on total attrition from technical training courses with special emphasis on the high-cost electronics courses that require a minimum score of 80 for admission. The reports are used also for briefings at higher echelons and for updating trends tables. These reports are also used by Headquarters Air Force, the Air Force Manpower and Personnel Center, Headquarters Air Training Command, and the Recruiting Service.

**Title:** Officer Effectiveness Report System

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**AFHRL Contact:** Charles A. Greenway  
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**Description:** Officers are normally given Officer Effectiveness Report (OER) evaluations once a year. The evaluations are used as (a) a tool in determining the individuals best qualified for promotion, (b) a tool for making assignments, (c) a counseling device, and (d) a general personnel management tool. The automated OER report system uses the OER records, which have been transcribed to magnetic tape to produce summary reports on a quarterly and yearly basis for grades of lieutenant through colonel separately. The reports aid assignment managers, career monitors, personnel managers, and OER monitors.

**Utilization:** The OER detail and summary reports have allowed Air Force managers, policymakers, major commanders, and separate operating agencies to track the progress of OERs and to identify trends, problems, and areas needing emphasis. In addition, the selection board secretariat uses the statistics in their pre-promotion board preparations. The data have been used in numerous briefings presented throughout the Air Force at all levels. On several occasions, information extracted from the reports has been briefed and discussed with Corona Conference audiences comprised of the Chief of Staff and major commanders. The system contains and reports information not available in any other automated personnel data system. The Air Force is in a better position to monitor the OER system as a result of the summary reports developed by AFHRL.



## TECHNICAL SUPPORT

### **Title:** Support to Other AFHRL Divisions

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**Description:** The Technical Services Division of AFHRL performs large-scale statistical services and data-processing support for Laboratory R&D programs. These services are performed in response to approved work requests initiated by all AFHRL divisions. In addition to the processing of work requests, this division reviews that processing to ensure complete and accurate results.

**Utilization:** During FY83, more than 300 work requests were processed, and approximately 235 work requests were open for processing at any one time. The following examples of R&D efforts illustrate the diversity of the work performed.

**Experimental Test Facility Support:** The Laboratory's Experimental Test Facility (ETF) located at Lackland AFB has been collecting data in two areas: (a) Basic parameters of learning ability measured with experimental tests constructed by in-house researchers that are administered to test subjects from Lackland Military Training Center on 30 individual TERA 8510 computers and (b) Perceptual-motor and cognitive performance evaluated with Basic Aptitude Tests (BAT) that are administered to candidates for pilot training on the same 30 TERA computers. The results from the testing sessions are consolidated onto magnetic tape using a PDP-11/34 computer. The Technical Services Division transfers the data to the Univac 1100 computer system, checking the files for reasonability and providing reports back to the test center in a quick-response mode in the event of data transfer problems. The immediate resolution of problems is critical to the success of this effort because the experimental tests are administered on interactive computers and cannot be reproduced. The volume of each file submitted for processing varies from 200,000 to 1,000,000 records. In the past year, 5,784,529 records have been processed.

**Armed Services Vocational Aptitude Battery (ASVAB):** The Technical Services Division performed analysis and programming on a wide spectrum of studies in the ASVAB area, including validation of various ASVAB forms, verification of ASVAB performance by a reference population, psychometric

analyses of a new high school ASVAB, processing support for item pool development activities, and post-enlistment verification of enlistment qualifications. Examples of work accomplished through these types of studies are described below.

The study, Validation of ASVAB Forms 8, 9, and 10, was processed for the AFHRL Manpower and Personnel Division. In preparation for the development of the new ASVAB forms to be implemented in calendar year 1984, analyses were required to validate ASVAB Forms 8, 9, and 10 as predictors of success in the various Air Force technical training courses and to investigate any possible test effects associated with race and sex of the enlistee. Data required for the study were assembled for 40,732 enlisted Air Force personnel from the Military Entrance Processing Stations transaction file and the technical training file. Computer products consisted of descriptive statistics, scatterplots, regression analyses, validation by race and sex, and cross validation.

Several ASVAB studies were performed for the Manpower and Personnel Division that involved the use of ASVAB data for subjects in the Profile of American Youth data file developed by the National Opinion Research Center (NORC) of the University of Chicago. In early FY 83 the study, Verification of 1980 Reference Population, was accomplished in response to a short-suspense request from the Director of Laboratories, Air Force Systems Command, to verify a report from the Center for Naval Analysis (CNA) on the effects of changing the norming reference population for ASVAB. The study was designed to verify the CNA analyses which were performed on the Profile of American Youth sample and to develop the data needed to justify the Air Force position on the use of the 1980 reference population in norming the ASVAB. In preparation for 1984 implementation of a new institutional (high school) ASVAB parallel to the military production ASVAB forms, the study Smoothed Norms and Item/Test Statistics for High School ASVAB was initiated to analyze the psychometric properties of ASVAB 8a as reflected by the Profile of American Youth Sample. The analyses were needed for preparation of counseling, reporting, and scoring materials to be distributed to high schools at the time of implementation. Specific analyses performed provided descriptive statistics, smoothings of test and composite score frequencies, percentiles of scores, and factor and item analyses. The analyses were accomplished on grade, ethnic group, and combination subsamples.

A variety of other ASVAB support studies were processed for the Manpower and Personnel Division. Among them were studies to perform answer sheet scanning and scoring and to provide item response data tapes for use by contractors working on the Omnibus Item Pool and Test Construction Project. In these studies, item response data for 14,000 basic trainees at 12 Military Recruit Training Centers and for 173,000 military applicants at 68 Military Entrance Processing Stations were processed and forwarded. Additional ASVAB scanning and scoring along with assorted analyses were provided for the study, Post-Enlistment Verification of Enlistment Qualifications. This study was accomplished to satisfy the requirement in AFR 35-8, para 7-8, which pertains to periodic checks of the integrity of the production ASVAB testing program. In the study, the response data of 1500 retested basic trainees per quarter were analyzed to check the incidence and sources of discrepant pre- and post-enlistment ASVAB scores.

Occupational Research Data Bank: Four data files were generated for the Air Force Occupational Research Data Bank (ORDB) statistical display system. These files consist of information extracted from the Uniform Airman Record (UAR) file, the Airman Gains and Losses (AGL) file, and the Pipeline Management System (PMS) file for Calendar Year 1981. The total statistical database of the ORDB now consists of summary tables for 1978-1981 with the data for 1978 and 1979 consisting of UAR and AGL statistics and summary counts and with the data for 1980 and 1981 comprised of UAR, AGL, and PMS statistics. Each year of UAR/AGL data in ORDB is based on over 500,000 records for airmen on active duty during the calendar year. The PMS data are based on more than 115,000 records for airmen in technical training during the calendar year. Each annual update generates and concurrently adds more than 190 summary and statistical tables to the statistical database.

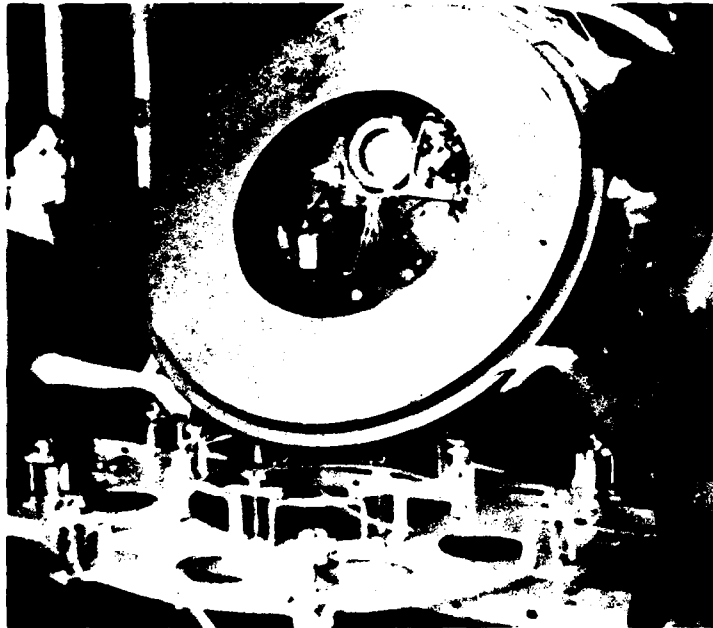
AFOQT Validation and Analysis: Continued evaluation and validation of the Air Force Officer Qualifying Test (AFOQT) by the AFHRL Manpower and Personnel Division resulted in numerous analysis requests involving such areas as (a) analyses of the test items that were common to both Form N and Form O (short battery) to develop percentile conversion tables, (b) item analyses, factor analyses, intercorrelations, regression analyses, and distributions with cumulative percentages to be used in the evaluation and calibration of the test

instrument; and (c) development of a "Quick Score" for use by recruiters at non-AFROTC test sites to determine if cut scores on the pilot, navigator, and/or verbal composites are met by examinees. Each "Quick Score" would indicate the probability of the examinee meeting or exceeding the composite cut score.

Additional analysis requests were accomplished for the Manpower and Personnel Division using the AFOQT database. Because AFHRL is the repository for AFOQT scores obtained at both AFROTC and non-AFROTC test sites, numerous inquiries are received from other agencies. Many of these inquiries can be answered from previously generated products, including microfiche containing data for each examinee. Through the use of these, a quick and economical response capability was developed. The detailed information is readily available and used to obtain insight and clarify issues pertaining to test performance, influence of college education, time lapse prior to allowing retest, influence of culture differences on test/retest performance, and influence of different test forms. Copies of the microfiche have been made available to other agencies such as the Air Force Aerospace Medical Research Laboratory (AFAMRL) to be used as a research tool for comparison of observed variables and other performance measures.

Air Force Reserve Officer Training Corps (AFROTC) and Officer Training School (OTS) Selection Validation: Numerous studies pertaining to the validation of current selection procedures used by AFROTC and OTS in selecting candidates for their commissioning programs were processed for the AFHRL Manpower and Personnel Division. This required the development of a database containing fiscal years 78 and 79 AFROTC selectees and fiscal years 80 and 81 OTS selectees. The data file includes information gathered from the weighted professional officer course selection system, OTS training record, OTS student performance ratings, AFROTC contract loss file, AFROTC database, experimental performance ratings, professional military education file, flying training file, officer effectiveness report file and the current active duty uniform officer record file. Final products were provided in the form of rosters, distributions, intercorrelation matrices, and regression analyses. These products will allow the investigator to evaluate the current selection procedures utilized and their effects as reflected by the selectees' training record and subsequent commissionees' active duty records.

## TECHNICAL SUPPORT



**Technical Services Analyzed  
Strength and Endurance**

**Strength and Endurance:** This collaborative effort between AFHRL and AFAMRL is designed to assess the physical job requirements for all Air Force enlisted specialties. Task-level physical demand estimates from supervisory personnel for eight Air Force Specialty Codes (AFSCs) were collected into standardized file structures. Detailed analyses consisting of descriptive statistics, index levels of interrater agreement, distributions and plots of task means, and distributions of task ratings were performed on 39 selected variables for each of the eight AFSCs.

**Transfer-of-Training Database for A-10, B-52 and KC-135 Aircraft:** The Technical Services Division produced benchmark files for the Operations Training Division of grade ratings for each crew position by sortie and event (task) for crewmembers of A-10, B-52, and KC-135 aircraft. Computer reports were developed to systematically reduce the data to statistical information which was meaningful and manageable by the research scientist. Reports of this type will allow the investigator to detect the effect of changes such as reduction in flying hours, or use of simulators in course content or method of presentation. The computer technology developed for the analysis of these data may be generalized to other R&D efforts that include repeated events.

### **Weighted Airman Promotion System (WAPS)**

**Analyses:** Data analysis support was provided to the Manpower and Personnel Division in three related studies designed to investigate alternative weighting systems for WAPS. The studies were initiated in response to a request from the Directorate of Personnel Plans (HQ USAF/MPX) to develop alternative weighting systems for the Airman Performance Report (APR) factor in WAPS to minimize promotion selection of airmen with recent, low APRs. Over 24 alternative weighting systems were evaluated in the three studies. In the process, each system was applied to airman records from three complete WAPS promotion cycles ( $N = 158,715$ ) in simulated WAPS selection runs. The resulting promotion outcomes under each alternative system were examined in terms of several criteria including effectiveness in eliminating selectees with recent, low APRs and impact on selection rates for minorities and women.

**Pilot Screening Research:** Extensive database development activities have been accomplished for the AFHRL Manpower and Personnel Division to support ongoing pilot screening R&D efforts. In its current stage of development, the pilot screening database is comprised of 9653 subjects and contains information from a variety of sources: Flight screening program results, Air Force officer qualifying tests, undergraduate pilot training summaries, and results from three experimental testing devices (Psychomotor, the Zero Input Tracking Analyzer, and the Automated Pilot Aptitude Measurement System). The database will be updated periodically and augmented with additional pilot training data to allow tracking of subjects through various phases of training.

### **Title: Support to Outside Agencies**

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**Description:** The Technical Services Division provides statistical services and data-processing support to approved agencies outside AFHRL. Work requests are initiated on behalf of the outside customers and then processed in the same manner as those for other AFHRL divisions.

**Utilization:** During Fiscal Year 1983, more than 25 studies were performed for outside agencies. The following items illustrate the range of these activities.

**Transfer of Technology:** Computer software developed and maintained by the Technical Services Division was provided to other Federal agencies with the approval of Air Force Systems Command. The Comprehensive Occupational Data Analysis Programs (CODAP) system was provided to the National Security Agency and the Navy Personnel Research and Development Center. The Air Force Electronic Security Command (ESC) and the Air Force Data Systems Design Center (DSDC) were provided copies of the AFHRL-developed general-purpose software libraries of over 300 programs. The DSDC is affected by the Air Force Phase IV contract with Sperry Corporation to replace all base-level computers with Univac 1100 systems. Since the 1973 implementation of the Univac 1100 at AFHRL, the Technical Services Division has developed an extensive library of computer programs, much of which has potential for use at other AF Univac sites. The software provided to ESC and DSDC will prevent duplication of programming tools, increase the efficiency of new program development efforts and enable the data processing staff to better utilize their new equipment.

**COMFY Olympics Scoring Item Analyses:** Optical scanning and data processing for personnel surveys and special testing were performed in support of the Electronic Security Command (ESC) COMFY Olympics program used to select and recognize the top three performers in each of 18 career fields. This is the fourth year that the Laboratory has provided this support to ESC, which uses the competitive program to upgrade and maintain job skills in each of the 18 career fields.

**AFOQT Centralized Scoring Systems:** Using a system of computer programs developed by the Technical Services Division, Air Force Manpower and Personnel Center (AFMPC) personnel located at the Laboratory at Brooks AFB processed 21,669 answer forms of Air Force Officer Qualifying Tests (AFOQT) administered during FY83. Individual test results are distributed to each test site. Microfiche reports from the quarterly master file updates are distributed to AFMPC and to the Recruiting Service. The total master file currently containing 45,606 records is maintained in the Technical Services Division for R&D purposes. The centralized system standardizes and guarantees the accuracy of AFOQT scoring throughout the country. The automated scoring system was modified to incorporate new tables for the conversion of full-battery raw scores to their percentile

values. These conversion tables were developed through an analysis of the Form 0 answer sheets which were processed by the system since its implementation in the fall of 1981.

**Reading Skills:** The Reading Skills and Requirements (Dec 82 UAR) study was performed for the Air Force Extension Course Institute (ECI). Reading grade level for all enlisted personnel of skill level 5 and below on active duty as of December 1982 was computed using a conversion technique developed by AFHRL. ECI uses the reading skills and requirements reports in conducting text quality control program. This report is essential when interpreting the relationship between reading grade level of ECI course materials and the reading skills and requirements of the student body.

**Top Block Officer Effectiveness Report (OER) Analysis:** An OER analysis study was performed for the Personnel Evaluation Division, Air Force Manpower and Personnel Center as a follow-on effort to FY82 studies that were concerned with identifying predictive demographic characteristics of personnel who receive top block OER ratings. The recent study investigated whether there are differences in the proportion of personnel receiving top block OERs as a function of the interaction between characteristics of the rater and ratee. Processing activities consisted of exploring categorical demographic variables for use in the study and performing Automatic Interaction Detection analyses to identify predictive interactions between rater and ratee characteristics with respect to the top block OER rating.

**Manpower Study of Wilford Hall Medical Center Nursing Division:** Data-processing and analysis support was provided to Detachment 26, Management Engineering Squadron (MET-26), Brooks AFB, in support of a manpower study of the WHMC Nursing Division. The work effort consisted of capturing and analyzing the daily workload data for each of Wilford Hall's 29 nursing units during a 9-month period. Summary reports were produced for each of the 29 nursing units and for the total Division on a monthly basis and across the 9-month period. The data were used in developing manpower standards for the Wilford Hall Nursing Division. Additionally, the automated patient classification data produced in this study were subsequently transferred to Wilford Hall Medical Systems Division to initiate a patient classification database for use in other Nursing manpower studies.

## TECHNICAL SUPPORT

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**Transfer of Historical Data:** The Technical Services Division provided data from several of its historical personnel databases to staff offices of the Directorate of Personnel Plans (HQ USAF/MPX), the Policy and Programs Office of Headquarters Air Force Systems Command, Air University, and the Air Force Occupational and Environmental Health Laboratory. These offices requested historical data from a variety of sources including the active duty and reserve uniform airman and officer record files, the processing and classification of enlistees (PACE) file, the airman reenlistment and losses (ARL) file and the weighted airman promotion system purge files. Data support provided to the Directorate of Personnel Plans was extensive with four separate requests for large-volume

data files. Three of the requests were in direct support of a joint project with the Rand Corporation to develop an enlisted inventory projection model for use in the Enlisted Force Management System. The historical data provided to HQ USAF consisted of (a) 1.3 million promotion records from five fiscal years for grades E-5 through E-9, (b) PACE and or ARL transaction data for 473,702 individuals who were Air Force members during FY81 and FY82, and (c) all ARL transactions ( $N = 7.3$  million) for any Air Force enlisted member having at least one transaction with an effective date of 1 Jan 71 or later.

## FACILITIES, SYSTEMS, FUNCTIONS

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The Technical Services Division of AFHRL maintains a general purpose Univac 1100 computer system to support research and development programs. Programs include extensive personnel research at AFHRL, medical research at the School of Aerospace Medicine (SAM), both headquartered at Brooks AFB, and occupational measurement by the Occupational Measurement Center (OMC) at Randolph AFB.

The Univac 1100 system includes a 3,072-square-foot computer room, and a 2,068-square-foot tape library which houses between 15,000 and 20,000 active tape reels. The tape library is a historical database of Air Force personnel files dating back to the mid-1950s. It contains 850 unique data files, the largest of which is the Airmen Reenlistment and Loss file containing over four million records dating from 1955 to 1983.

The computer hardware will accept data tapes written in all standard formats. This allows the laboratory to accept data collected by other organizations on their computer systems. It also permits AFHRL to prepare tapes in formats acceptable to other organizations. The U1100 system supports major programming languages including FORTRAN, COBOL, and database management systems including Univac's DMS 1100 and Intel's System 2000. Over 300 people are authorized use of the U1100 through a variety of access routes. Means of access include dial-up telephone lines, dedicated telephone lines (these service Williams AFB, and Randolph AFB) and are directly connected to terminals at AFHRL. Univac 1100 users include AFHRL and SAM scientists and contractors, as well as occupational survey analysts from OMC.

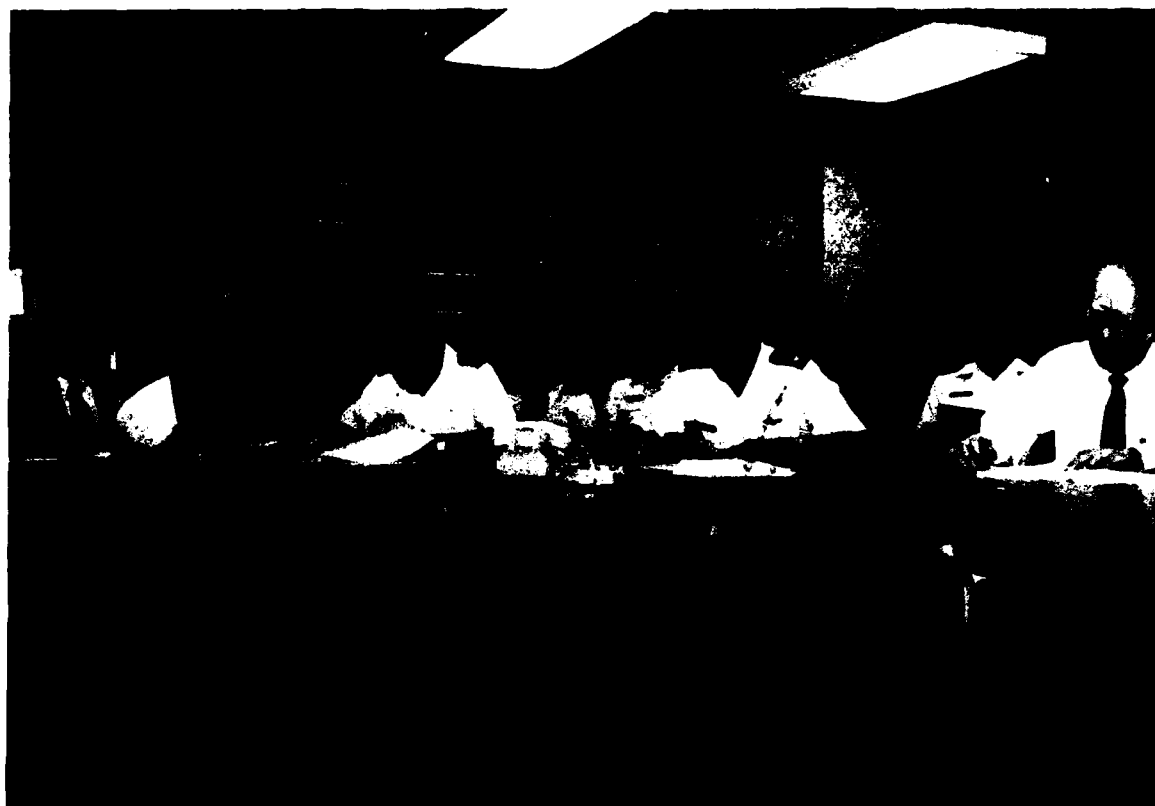
## COMPUTER FACILITIES

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The Technical Services Division also operates and maintains a Digital Equipment Corporation VAX 11/780 Computer System. This system provides automated management information systems in support of R&D projects within AFHRL and interfaces with the ARPANET communications network. In addition to the central computing facility at Brooks AFB, AFHRL has computer resources at Williams AFB, Lowry AFB, and Wright-Patterson AFB. The Automated Data Processing Equipment (ADPE) at Williams AFB consists of nine Systems Engineering Laboratory (SEL) 32/75 computers, three SEL 8600 computers, one SEL 7200 computer, a Univac 400 terminal system consisting of two CRT terminals and a printer, a Univac 700 remote batch terminal, and a Univac 200 terminal and printer. The ADPE at Williams AFB supports the Advanced Simulator for Pilot Training (ASPT), which in turn supports the primary mission of AFHRL Operations Training Division.

Located at Lowry AFB is a Control Data Corporation CYBER 170-730. This system is used to develop programs for computer-managed instruction and computer-assisted instruction. The system is used as a research tool for the development and evaluation of computer-based education and training.

Located at Wright-Patterson AFB is a DEC PDP 11/45 System which supports a research and development project for ground operations training. The objectives are to reduce training time and to improve performance of weapons directors in missile and space command and control systems. The project will use a special purpose, high resolution, color raster scan three-dimensional graphics display system.



Audio Teleconference in Progress

Audio teleconferencing was introduced to the headquarters and remote divisions in May 1981 to demonstrate the overall capability. Various audio teleconferencing equipment is being tried in order to determine the type of system that best fulfills the AFHRL requirements. A large screen projection system was installed in April 1981, primarily to project color graphics. Current capabilities allow projecting video images from standard television, video disk, and video tape. This system will be used to project color graphic displays in near real time using a minicomputer to produce the graphic illustrations using the System 2000 database. It became the foundation for a future management teleconferencing system at AFHRL and will ultimately support data, graphics, voice, and slow-scan or freeze-frame television images. Remote divisions will be similarly

equipped and thus provide the capability to conduct full-scale teleconferences between two or more locations.

The capability for this type of presentation, though developed to ultimately link the five AFHRL divisions dispersed across four states, has potential application for all geographically separated military organizations.

Temporary duty costs have plummeted while the organizational interaction has improved in efficiency and frequency through the high quality full color business graphics and the latest in phased array microphone audio technology.

## LABORATORY OPERATIONS CENTER



Podium Demonstration of  
Projected Information

The Laboratory Operations Center (LOC) is the focal point for collecting and displaying data used in the management of the AFHRL technical program. The software for input of data at the source has been completed and three of the AFHRL divisions and the Plans and Programs Office have been on line with source data entry for up to seven months. Textual data are being input into the MASIS directly out of the AFHRL database. Within the next 3 to 6 months, all data inputs into either MASIS or JOCAS will originate from the AFHRL database. Personnel throughout AFHRL retrieve data and produce reports using the AFHRL database and System 2000. The LOC can provide various types of color output, such as textual slides, pie charts, bar graphs, and line graphs, suitable for viewgraph and 35mm projection.

## OFFICE AUTOMATION

Office automation within AFHRL is currently supported by a Wang Laboratories VS-80 computer. This equipment provides an automated word processing capability, as well as electronic mail service among AFHRL Wang users. Computer terminals and printers located throughout AFHRL allow users to create, edit, revise, and print correspondence. In the past, these functions normally were done with typewriters. These devices greatly increase the ease and efficiency with which this correspondence is handled. In addition, all correspondence is filed on magnetic disks for later retrieval and use as needed or for deletion when no longer required. The electronic mail feature allows transmission of correspondence to and from any of the AFHRL divisions. At preset times during the work day, long distance telephone calls are automatically made to each remote location and any mail items are distributed. Mail items from the remote locations are also picked up at those times and delivered to the proper recipient, whether at Brooks AFB or at another remote location. Urgent correspondence is handled on a priority basis, with delivery to the receiving system generally occurring within 15 minutes. These features of the office automation system greatly reduce the paperwork burden of AFHRL personnel in accordance with the Paperwork Reduction Act of 1980 (PL-96-511) and streamline the many administrative tasks necessary in today's offices.

## TECHNICAL EDITING OFFICE

Technical Editing Office serves as the focal point for publishing the results of research and development projects. Technical editing, copy editing, and final composition of reports, journal articles, professional papers, brochures, and other documents are accomplished in this office. Guidance is provided to authors and contract monitors to ensure that technical reports comply with Government regulations and professional standards. Further, the office staff composes the camera-ready final copy of reports, tests, survey forms, questionnaires, and brochures; maintains liaison with the Public Affairs Office to obtain clearance of technical reports for public release; coordinates printing requirements; and distributes technical reports, special reports, technical papers, and TRACEs (a 1,000-word summary of a technical report).

## SCIENTIFIC AND TECHNICAL INFORMATION OFFICE

The Scientific and Technical Information (STINFO) Office plans and directs the STINFO program, including the Technical Library, to meet the information needs of scientific and technical personnel in managing, monitoring, and conducting research and development. STINFO monitors the AFHRL technical publications program, plans and directs the recording of the corporate history, and directs the AFHRL contract data management program. STINFO also serves as the AFHRL foreign disclosure policy office and determines releasability of military information to foreign nationals. The Office maintains close liaison with foreign technology personnel to ensure that foreign research results are available to Laboratory personnel. Further, the Office serves as the focal point for small business and potential contractor programs, patents/inventions/ copyrights, security and policy review, and other related programs.



STINFO Personnel

### LIBRARY FACILITIES

The services provided by the AFHRL Library include the acquisition of books, journals, and other library materials. These services are provided for the command staff offices and the divisions on Brooks AFB, as well as for divisions and offices located in other geographical areas.

Library holdings at the end of FY 83 were 13,310 books and bound volumes of journals, 11,689 technical reports and 481 journal subscriptions. The office collection at the Logistics and Human Factors Division, Williams AFB, includes 472 books and 32 journal subscriptions. The collection at the Training System Division, Lowry AFB, includes 257 books and 50 subscriptions. The library continued its policy of not binding journals available on 16mm microfilm and of obtaining backfiles for new subscriptions on microfilm.

The Library had online access to Dialog Information Services, Inc. at Palo Alto, California, the Defense RDT&E On-Line System, at Alexandria, Virginia and OCLC (Online Computer Library Center, Inc.) at Dublin, Ohio.

The Library participates in three local consortia--the Council of Research and Academic Libraries of San Antonio (CORAL), the Health Oriented Libraries of San Antonio and the San Antonio Area Online Users Group. A major project completed during the summer was the revision of the journal holdings records and their submission for inclusion in CORAL union list of serials.



AFHRL Technical Library



## **MANAGEMENT AND SCIENTIFIC INFORMATION SYSTEM**

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The Management and Scientific Information System (MASIS) is designed by and for research and development program managers in the Air Force Systems Command. The system integrates financial, technical program, and procurement status data into a single database. Even though all the information systems at the Department of Defense level are still being designed to satisfy the needs of a single functional area, the integration of the laboratory information into a single database permits maximum use of the data with a minimum amount of input.

Work unit data in MASIS are recorded and retained at the funding action level. For in-house work, the funding action is initiated for the annual estimate of resources. Estimates are updated to actual amounts at the close of each fiscal year from data extracted

from the Job Order Cost Accounting System. Funding action for a specific contract or grant is linked to the basic contract or grant record. The basic contract and all follow-on contracts or grants that are a part of the same work effort are mechanically linked together.

The MASIS programmed subsystems are designed for flexibility. The computer programs, rather than being a collection of independent programs that must each be altered when changes are made to the system, are instead a highly integrated system of programmed subsystems that provide the flexibility and responsiveness required of a management information system. Today, MASIS represents the most comprehensive common system link among all Air Force Systems Command laboratories.

## **JOB ORDER COST ACCOUNTING SYSTEM**

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The Job Order Cost Accounting System (JOCAS) consists of more than 80 interactive computer programs used by the Air Force Systems Command for the mechanized accounting of all its resources. All funds and labor are channelled into this system by the base finance units and the laboratories. AFHRL receives over 40 JOCAS reports monthly detailing the resources expended by current month, as well as by year-to-date accumulations.

The JOCAS reports provide resources information to assist managers in optimizing their use of manpower and funds and also in planning for future requirements. Each work unit is identified by a unique job order number and all resources directly supporting a particular work unit are charged to that unique number. One of the primary uses of JOCAS is to identify and track all reimbursement earnings to

assure that the reimbursement programs are earned fully, that the proper organization is billed for these earnings, and that these earnings are credited to the unit which earned them.

Various JOCAS reports are analyzed to detect trends in the use/expenditure of AFHRL manpower and funds. Studies are conducted to identify AFHRL direct and indirect labor trends for total laboratory manning, as well as for scientific and engineering personnel and technicians. Similarly, studies identify the funds expenditures in various categories, such as customer, technical planning objective, direct, indirect, and systems. These studies show historical trends over several years and provide valuable management information for optimizing the use of AFHRL resources.



# SPE EVENTS





Change of Command Ceremony

Col Alfred A. Boyd, Jr. assumed command of AFHRL April 29, 1983 in a change of command ceremony held in conjunction with the retirement of Col Ronald W. Terry. Col Terry had been AFHRL Commander since July 21, 1978. A command pilot with more than 3,000 flying hours, Col Boyd managed training programs for Air Force personnel during the first two flights of the Space Shuttle Columbia. His military decorations include the Silver Star with two oak leaf clusters, distinguished Flying Cross with one oak leaf cluster, and 19 air medals.



The Air Force Human Resources Laboratory was realigned under the USAF Aerospace Medical Division on 1 March 1983.

USAF Aerospace Medical Division Logo



**Major General Vince Luchsinger**

The Manpower and Personnel Division coordinated a productivity R&D planning workshop at Brooks AFB, 20-23 Sep 1983. The purpose of the workshop was to identify Air Force productivity R&D needs, determine research objectives, and provide recommendations for AFHRL productivity R&D programs. Maj Gen Vince Luchsinger, HQ AFSC, presented the keynote address focusing on Air Force productivity issues.

Dr. Robert M. Gagne, recipient of the Distinguished Scientific Award for the Applications of Psychology for 1982, contributed his expertise to AFHRL projects during FY82. In his 5 months tenure at AFHRL, one of Dr. Gagne's major efforts was to assemble a blue-ribbon panel of experts in human learning and instruction to provide Lt Col David L. Payne, Chief, Test and Training Research Branch, with a set of recommendations concerning appropriate goals for learning and training research in the Air Force. Dr. Gagne also served as a consultant to Dr. Raymond E. Christal and his colleagues in the Learning Abilities Measurement Program.



**Dr. Robert M. Gagne**



# DEPARTMENT OF THE AIR FORCE

**This is to certify that  
THE AIR FORCE OUTSTANDING UNIT  
AWARD**

**has been awarded to the**

**AIR FORCE HUMAN RESOURCES LABORATORY**

**AIR FORCE SYSTEMS COMMAND**

**For exceptionally meritorious service**

**1 JANUARY 1981 TO 31 DECEMBER 1982**

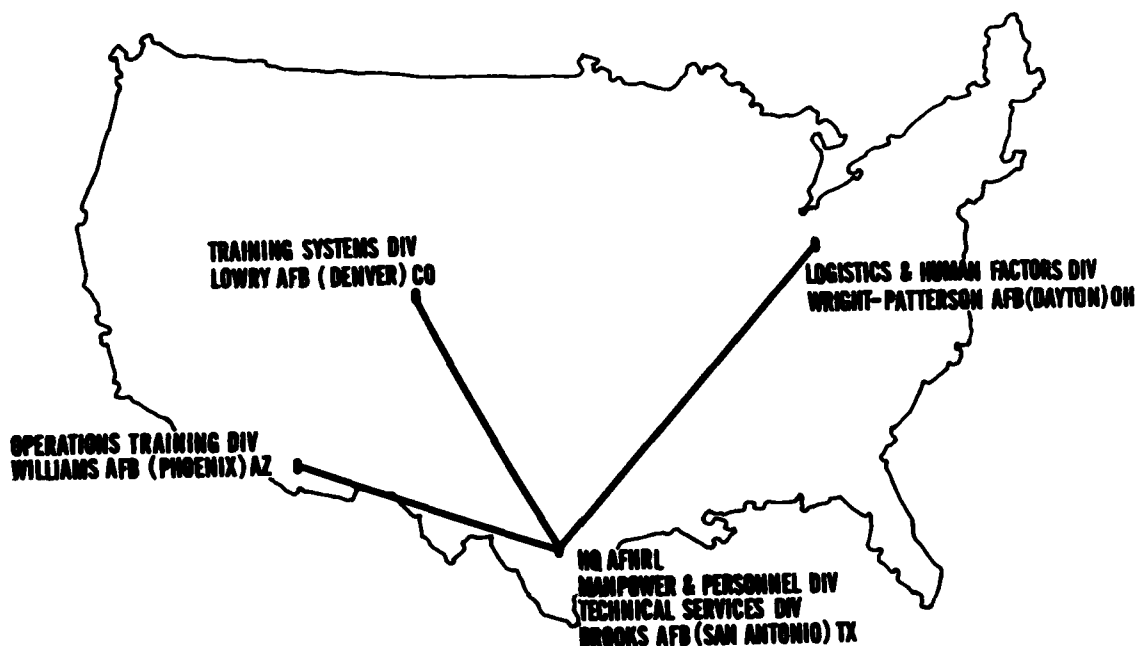
**Given under my hand in the city of  
Washington this 21ST DAY OF JULY 1983**

SECRETARY OF THE AIR FORCE

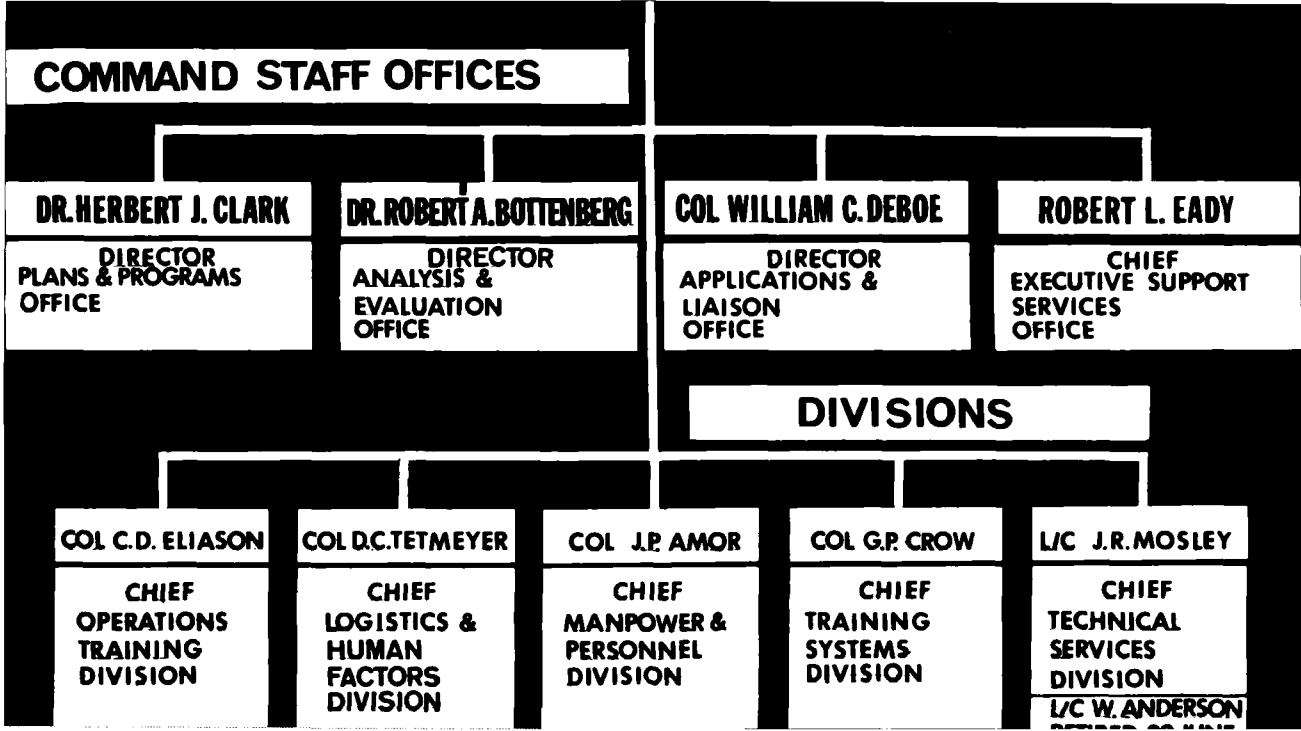


# **AFHRL ORGANIZATION**

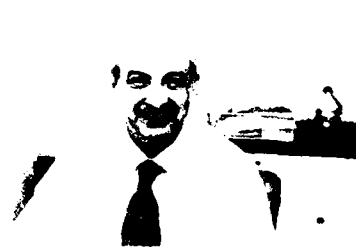
## AFHRL GEOGRAPHICAL LOCATIONS



The Air Force Human Resources Laboratory is structured for centralized management and decentralized operation. From Brooks AFB, the command staff manages the R&D programs; the divisions, at their various locations, perform the R&D and support activities. Each R&D division is located in close proximity to major users of its products. The above map depicts the geographical locations of the AFHRL divisions and activities. The Logistics and Human Factors Division is collocated at Wright-Patterson AFB, Ohio, with relevant user commands such as the Air Force Logistics Command, the Aeronautical Systems Division, the Aerospace Medical Research Laboratory, the Air Force Wright Aeronautical Laboratories, the Air Force Acquisition Logistics Division, and the Simulator Systems Program Office. The Training Systems Division is collocated at Lowry AFB, Colorado, with the Air Training Command (ATC) Lowry Technical Training Center. The Operations Training Division is collocated at Williams AFB, Arizona, with an ATC Undergraduate Pilot Training Wing; a Tactical Fighter Wing is at nearby Luke AFB. In San Antonio, Texas, at Brooks AFB, the Manpower and Personnel Division is collocated with the Aerospace Medical Division and the USAF School of Aerospace Medicine. In close proximity is the Manpower and Personnel Center and Headquarters, ATC at Randolph AFB. The Air Force Military Training Center is located nearby at Lackland AFB. The Technical Services Division, also at Brooks AFB, supports the AFHRL scientific and technical program.







**COMMAND  
STAFF PERSONNEL**



The Vice Commander assists the Commander in the performance of his command function and commands the Laboratory in the absence of the Commander. The Vice Commander chairs the Laboratory's Corporate Planning Group (CPG) and the Corporate Planning Group Executive Committee (CPGEC).

The CPG is responsible to the Commander for recommendations and priority assignments on laboratory policy, short- and long-term goals, and overall mission and thrust alternatives. The CPG consists of the Vice Commander, the Chief Scientist, the Directors of Headquarters Staff Offices, the Division Chiefs, and the Executive Officer (Recorder). The CPG meets at least once annually.

The CPGEC consists of the Vice Commander, the Chief Scientist, the Directors of Headquarters Staff Offices, and the Executive Officer (Recorder). The CPGEC acts for the CPG between CPG meetings and meets at least once monthly.

Normal functions of the CPGEC are the following:

a. Upon the Commander's approval, the committee disseminates policy or guidelines to, or



Colonel Anthony F. Bronzo, Jr.  
Vice Commander

requests reports or information from, any AFHRL organization element or other offices and agencies.

b. The committee reviews the Technical Advisory Board recommendations regarding the Laboratory's RDT&E program for compliance with policy, goals, objectives, and priorities.

c. It forwards recommendations regarding the RDT&E program to the Commander, with comment.

d. Upon the Commander's approval, it forwards the Commander's Approved RDT&E Program to the operating RDT&E divisions and various staff offices through the Plans and Programs Office.

e. Finally, the committee makes recommendations to the Commander for assignments of divisional and staff office responsibilities and added efforts, including new technical thrusts.



Colonel Kenneth E. Stout  
Retired September 30, 1983

## **EXECUTIVE SUPPORT OFFICE**

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**Robert L. Eady**  
**Chief**

The Executive Support Office develops and implements policies, procedures, and standards relating to administration management and practices, military and civilian personnel and manpower actions, and materiel actions. The Office provides staff guidance, assistance, and surveillance over other echelons in areas of functional responsibility for the Laboratory Commander. The office staff evaluates administration, personnel, and materiel procedures in other functional areas within the Laboratory and operates the following programs: manpower and organization; forms, publications and reports management; document security; military and civilian personnel administration (including training programs); and organizational supply. Further, the Executive Support Branch is the principal focal point for host-tenant support agreements for the Laboratory and off-base divisions; represents the Laboratory in dealings with other agencies and higher headquarters in all areas of functional responsibilities; and serves as focal point for Inspector General visits and reports.



**Dr. Herbert J. Clark**  
**Director**

The Plans and Programs Office plans, implements, and manages the conduct of the AFHRL Research, Development, Test and Evaluation (RDT&E) program. Staff members perform long-range planning that combines higher headquarters guidance, Air Force user requirements, and technological opportunities. This office publishes all planning documents and prepares budget submissions to higher headquarters. The Plans and Programs Office effects program implementation by processing financial and budgetary documents and monitoring the progress of all support, contractual, and in-house RDT&E efforts. The office provides the resource management required to execute effectively the RDT&E program.

The Director of Plans and Programs is responsible to the AFHRL Commander for the proper operation of the Plans and Programs Office and bears responsibility for the Laboratory's staff mission in plans and documentation, operations, programs, and financial management. The Director serves as a member of the Corporate Planning Group and its Executive Committee.

## APPLICATIONS AND LIAISON OFFICE

The Applications and Liaison Office is responsible for promoting the transfer of R&D end products to the operational community, for assessing the use of these products, and for fostering closer coordination between researchers and user organizations. The office monitors, evaluates, and provides AFHRL managers with feedback on the utilization of completed R&D.

A new R&D Product Utilization Assessment program was developed in the Applications and Liaison Office in mid-1982 and was initiated in early FY83. In order to implement this program, a new assessment methodology was developed which included a new R&D Utilization Assessment form to replace the survey previously used.

The actual tracking of an R&D product consists of several critical stages. First, products are identified for tracking and all background information is gathered. The applications manager subsequently forwards the R&D Product Utilization Assessment questionnaires to users and visits appropriate sites to see how the product is being used. After all related information has been gathered, the applications manager prepares a report based on the findings and coordinates all information with the appropriate division. Later, the Laboratory Commander and his staff are briefed on the findings of each assessment.

Since the initiation of the new program, the utilization of three products has been assessed. The assessment of a product from the Manpower and Personnel Division culminated in a Special Report, AFHRL SR 83-23, "Air Force Reading Abilities Test: Utilization Assessment", currently in publication. "The Handbook for Selection of Format Options for Procurement of Technical Data" has been assessed and the findings have been coordinated with the Logistics and Human Factors Division. Utilization of the U-2/TR-1 Cockpit Procedures Trainer has also been assessed for the Operations Training Division.

This office is also charged with fulfilling the requirements of the Stevenson-Wydler Technology Innovation Act of 1980 which mandates that Federal research agencies disseminate the results of their R&D to state and local governments and to the private sector. To carry out this function of wider technology transfer, an Office of Research and Technology Applications has been established.

The Applications and Liaison staff manages the Independent Research and Development (IR&D) program for AFHRL. Through this program scientists and engineers evaluate the R&D projects of private



Colonel William C. DeBoe  
Director

industry that may have a potential application to a military function or operation. Personnel of this office review the technical plans submitted by commercial firms, solicit and summarize external evaluations, and coordinate on-site technical reviews of IR&D performed at AFHRL designated-firms. The results of technical evaluations are used in the determination of negotiation objectives for IR&D advance agreements. In FY83 AFHRL evaluated 220 projects worth 74. 8 million dollars.

Finally, the office publicizes the Laboratory R&D programs through the Air Force Report on the Utilization of People-Related Research, Development, Test, and Evaluation, the AFHRL Annual Report, the Quarterly Newsletter, and informational flyers and brochures.

The Director is responsible to the Laboratory Commander for the proper operation of the Office and bears responsibility for the Laboratory's staff mission in RDT&E applications and liaison. He serves as a member of the Corporate Planning Group and its Executive Committee.



**Dr. Robert A. Bottenberg**  
**Director**

The Analysis and Evaluation Office at AFHRL is responsible for the planning and execution of studies to evaluate potential benefits and costs for major AFHRL Research, Development, Test, and Evaluation (RDT&E) programs. Through direct interaction with project managers and Air Force users, plans are identified for the development, testing, acquisition and deployment of products and systems. Studies conducted by this office provide the AFHRL Commander and the Plans and Programs Office with information concerning potential force-multiplier effects and life-cycle benefits and costs which are anticipated from the investment of resources in major programs. The Analysis and Evaluation Office provides guidance to AFHRL Divisions in the development and estimation of research and development costs. Finally, the staff is responsible for the conduct of special studies which focus on Laboratory operations.

The Director of Analysis and Evaluation is responsible to the AFHRL Commander for the proper operation of the Office and bears responsibility for the Laboratory's staff mission in analysis and evaluation of planned and ongoing RDT&E. The Director also serves as a member of the Corporate Planning Group and its Executive Committee.



LOGISTICS  
AND HUMAN  
FACTORS  
DIVISION



## **R&D AND SUPPORT DIVISIONS/LOGISTICS AND HUMAN FACTORS DIVISION**



**Colonel Donald C. Tetmeyer**  
Division Chief

The prime objective of the Logistics and Human Factors Division's thrusts are to provide the technology to ensure effective and efficient support of Air Force operations. This support includes planning and management of both material and human resources. Special attention is devoted to maintenance. Also included as an objective is the technology to ensure effective team performance in ground-based systems. The area consists of three interrelated subthrusts: (a) Acquisition Logistics, (b) Combat Logistics, and (c) Command and Control Team Performance Training.

The first subthrust concerns the process by which support for new systems are designed and planned. It includes the development of new analysis techniques, automation of logistics models and databases, and the development of logistics analysis methods in computer aided design software. The object is to provide the capability to create supportable designs from the point of inception.

The second subthrust is aimed at maintenance capability for deployed combat operations. It includes technology to improve maintenance

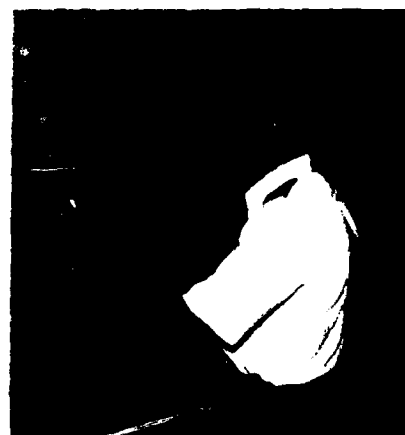
diagnostics technology for integrated logistics support of weapon systems, improved techniques for planning maintenance and logistics for combat environments, and technology for automating logistics elements such as technical data.

The third subthrust is aimed at improving the performance of non-flying crews, groups, teams and units. Special attention is being given to teams involved in tactical command and control systems because of the pressing current needs for improvements to meet the threat.

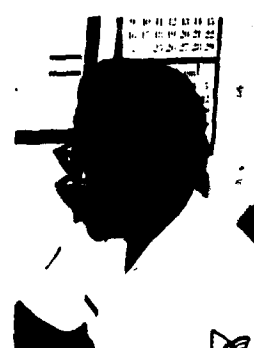
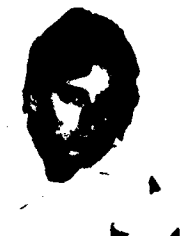
R&D investment in the area of these subthrusts promises unusually high payoff. The potential to reduce cost and increase weapon system supportability is high because this area of technology is quite underdeveloped and initial big-step improvements can be made. The subthrusts have been the subject of unusually high-level interest. Special scientific and operational study groups have stressed the need for increased R&D in the subthrust areas.







**TRAINING  
SYSTEMS  
DIVISION**



## TRAINING SYSTEMS DIVISION



**Colonel Graham P. Crow**  
Division Chief

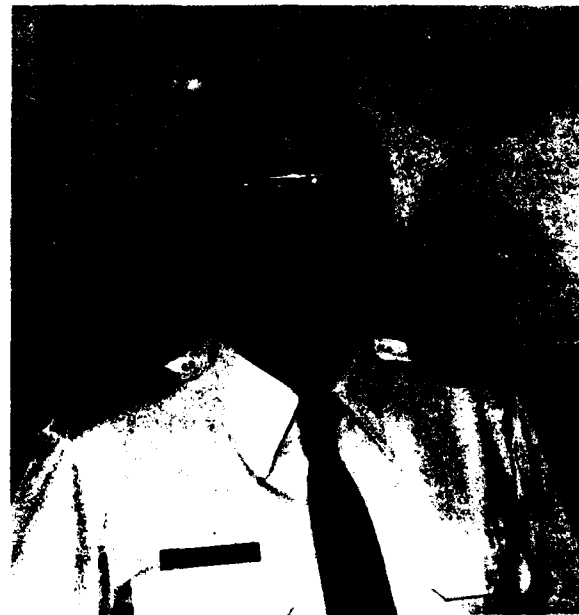
The Training Systems Division located at Lowry AFB, Colorado, has the primary objective of developing improved methods and strategies for initial skills development and enhanced job performance by upgrading individual and unit training. Specific technical objectives include development and demonstration of improved training methods, instructional and learning strategies, and training design and evaluation techniques. Other objectives relate to the development of computer-based training and job-aiding systems including transportable computer software to support instructional systems, maintenance simulation systems, and the application of intelligent systems technology to training and job-aiding.

The Training Design and Delivery Thrust is structured to develop, integrate, and demonstrate improved training systems and technologies for both individual on-the-job and unit training programs. The thrust objective is addressed through work in two subthrusts: Skills and Performance Specification Systems and Training Management and Delivery Systems.

The Skills and Performance Subthrust incorporates R&D on the content and process of instruction;

instructional and learning strategies; definition of training and performance requirements; performance assessment, evaluation, and training quality control; cognitive and motivational aspects of instruction; and artificial intelligence applications to instructional delivery and support.

The Training Management and Delivery Subthrust addresses R&D on development and management of instruction for both formal and on-the-job training. Included are efforts pertaining to the use of computer-aided/managed instruction and maintenance simulation. Overall, the Training Systems Division has an applied research focus, with exploratory development work occurring in both Division subthrusts. The basic research activities of the Division are oriented mainly toward skills acquisition, while advanced development work falls mainly in maintenance simulation and on-the-job training.



**Lt Col Allen J. Partin**  
Division Chief--2 June 1980--15 August 1983



**MANPOWER  
AND PERSONNEL  
DIVISION**



## MANPOWER AND PERSONNEL DIVISION



**Colonel J. P. Amor**  
Division Chief

The main objective of the Manpower and Personnel Division's R&D program is to ensure that the Air Force is able to maintain a quality career force of skilled and motivated people. To help the Air Force meet this objective, the Manpower and Personnel Division of AFHRL has an R&D program designed to improve ways to attract the most qualified individuals, optimally assign them where they will be the most productive, and retain a sufficient number in the career force to meet operational requirements.

To support the Division's major thrust, i.e., Manpower and Force Management, R&D is conducted to develop management tools, procedures and associated technologies to improve procurement, selection, classification, utilization, productivity, and retention of Air Force personnel. Results of this R&D provide a substantive basis for personnel decisions in all phases of the military life cycle to maximize the utilization of talent and to ensure that manpower resources are allocated to maximize the return on personnel investment.

Matching the right person with the right job requires an accurate assessment of job demands and individual abilities. The capability to assess an individual's aptitudes, interests, experience and educational background depends on an ongoing R&D program to develop and refine the personnel measurement techniques. As for the job component side, ongoing projects include methods for collecting and analyzing occupational information and the establishment of

entry level requirements in terms of aptitude, basic skills, physical strength and stamina, experience, and education. The Division also manages the R&D requirements in support of the tri-service operational testing program - the Armed Services Vocational Aptitude Battery.

New R&D efforts focus on the development of analytical tools for efficient management of manpower resources and the identification and forecasting of personnel problems. Computer-based models for skill requirement projections, retention analyses, training decisions and assignment/reassignment actions are being developed. They will update and fill critical gaps in the characterization of the manpower, personnel and training system and will provide a firmer basis for informed policies and effective management decisions.

In order to maintain sufficient quantity and quality of personnel in the career force, the Manpower and Personnel Division is also conducting studies to improve personnel utilization, retention, productivity, workgroup effectiveness, and career motivation. In addition, a series of R&D efforts has been initiated to develop on-the-job measures of individual performance. Such measures will provide the legally mandated criterion measures to validate the ongoing selection, classification, and training programs in the Air Force.



**Dr. Nancy Guinn**  
Technical Director



OPERATIONS  
TRAINING  
DIVISION



## OPERATIONS TRAINING DIVISION



**Colonel Carl D. Eliason**  
Division Chief

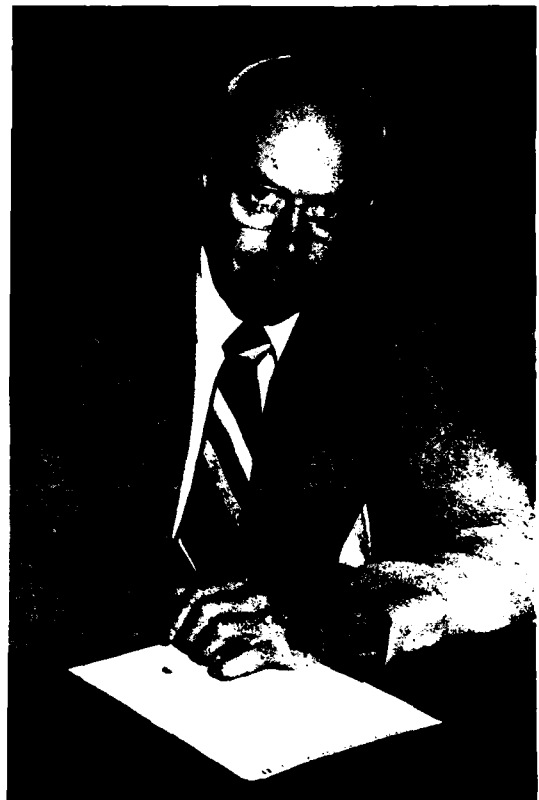
The primary objective of this thrust is an Air Combat Training Technology that identifies and demonstrates, in cost-effectiveness terms, alternative training strategies and training equipment capabilities for use in obtaining, improving, and maintaining the skills and combat effectiveness of USAF aircrew members. The thrust consists of three subthrusts: (a) Aircrew Training Systems, (b) Aircrew Training Applications, and (c) Technology for Aircrew Training Simulation.

The objective of the Aircrew Systems subthrust is to provide a technology base for training high-level aircrew performance skills through the use of simulated combat environments. Current R&D focuses on the development of training strategies and equipment requirements for use in the training of offensive and defensive tasks using wartime tactics in a realistically modelled combat arena.

The Aircrew Training Applications subthrust has as its objective the integration of operationally applicable findings into ongoing unit training programs to improve both efficiency in training and the effectiveness of operational aircrew capabilities. It will integrate the full range of training-delivery capabilities from microcomputer-based special function trainers to full field-of-view full mission simulators.

The Technology for Aircrew Training Simulation focuses on the development of mission simulator components and techniques that provide greater training capability. It includes the development of advanced computer image generation technology, as well as projection and display technologies to provide full field-of-view visual scenes for use in flight simulators. Outstanding is the development of a simulation capability to train low altitude navigation, targeting infrared tasks.

In the near term, the products of this thrust are providing the equipment and training technologies necessary to teach basic air combat skills and tactics. In the longer term, this thrust will increasingly address the training of those air combat skills required to be successful in specific combat areas and to function effectively as a member of a coordinated combat team. The benefits of R&D success in this thrust will be increased mission readiness for operational aircrews.



**Dr. Milton E. Wood**  
Technical Director



**TECHNICAL  
SERVICES  
DIVISION**



## TECHNICAL SERVICES DIVISION



**Lt Col James R. Mosley**  
Division Chief

The Technical Services Division operates the AFHRL scientific, research, mathematical, and statistical computer data-processing center in support of the other Laboratory Divisions and performs statistical analyses of personnel and training R&D data for Laboratory scientists and a variety of Air Force offices. The major organizational elements within the Division are the Computer Programming Branch and the Computer Operations Branch. The Division also includes the Information Resource Management Office, and the Technical Editing Office. The Executive Support Branch was assigned to the Division for a part of the year before becoming an office under the Command section.

The primary thrust of the division is to provide information processing and analysis. This objective encompasses providing personnel data analysis in support of the Laboratory R&D programs and technical and management support to enhance productivity within the Laboratory.

The Division develops, maintains, and updates automated personnel and training R&D banks and computer-based analysis techniques, including procedures which permit analyses of longitudinal and cross-sectional databases, in support of R&D studies across the manpower, personnel, and training spectrum. The extensive data banks, coupled with a powerful library of computer software designed to provide efficient and cost-effective methods for

achieving highly accurate results, are used to perform analyses of scientists' work requests. Quality control and audit activities are performed for all data-processing and analysis phases to ensure adequacy and accuracy of computer products.

The Division operates a large-scale multiprocessor computer facility, including peripheral equipment for support of the R&D programs of the Laboratory. Operation of the computer facility includes system support activities such as updates to the operating system, compilers, database management systems, communications, and inter-computer file transfer. Data entry facilities and services complement the Laboratory computer facility. The division also maintains systems to facilitate the rapid transfer of information between the Laboratory's geographically separated Divisions and the Command staff.

The Division directs the scientific and technical information program, including the technical library, to meet the information needs of scientific and technical personnel in managing, monitoring, and conducting R&D. Further, the Division provides a full range of technical editorial services, plans and directs the recording of corporate history, provides staff administrative services, and serves as the focal point with supporting organizations.

The Division is initiating new research on a Database Research System that will be a dynamic modular system relating to the total officer and airman force, and will incorporate technology capable of providing timely responses to queries from operational personnel and behavioral scientists. The database will include manpower, personnel, and exogenous data such as unemployment rates, civilian and military wages, and other labor force statistics.

The Chief of the Technical Services Division also serves as a member of the Corporate Planning Group and of its Executive Committee.



**Lt Col Wendell L. Anderson**  
Retired June 30, 1983



# **AFHRL RESOURCES**

**DISTRIBUTION OF AUTHORIZED PERSONNEL FY83**

<b>BY DIVISION</b>		<b>CLASSIFICATION</b>	
<b>MANPOWER &amp; PERSONNEL</b>	<b>77</b>	<b>OFFICERS</b>	<b>62</b>
<b>LOGISTICS &amp; HUMAN FACTORS</b>	<b>56</b>	<b>AIRMEN</b>	<b>72</b>
<b>OPERATIONS TRAINING</b>	<b>67</b>	<b>CIVILIANS</b>	<b>237</b>
<b>TRAINING SYSTEMS</b>	<b>31</b>		
<b>TECHNICAL SERVICES</b>	<b>104</b>		
<b>HEADQUARTERS</b>	<b>36</b>		
<b>TOTAL</b>	<b>371</b>	<b>TOTAL</b>	<b>371</b>

FISCAL YEAR 1983

**FUNDING SUMMARY (\$1000)**

FY 81	FY 82	FY 83
580	825	790
1,330	1,156	1,156
18,181	19,671	23,786
4,839	6,683	16,789
3,570	5,056	8,547
28,500	33,391	51,068

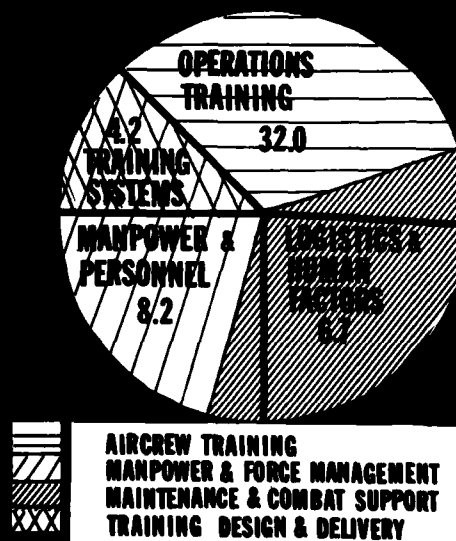
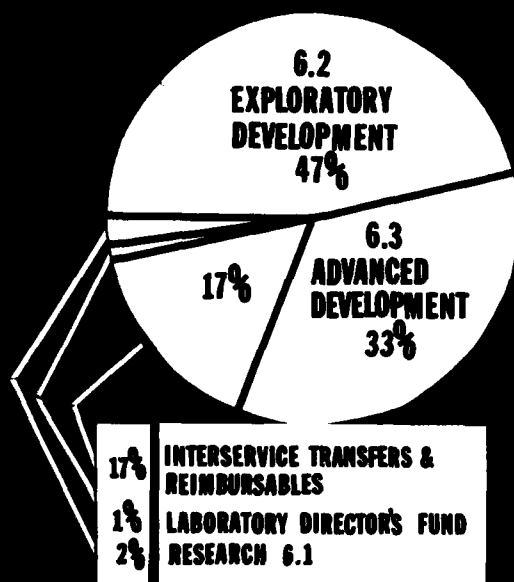
## INVESTMENT STRATEGY

The goal of the AFHRL R&D program is to ensure combat success by optimizing human performance. This emphasis on personnel is based on a growing awareness that complex systems require extremely well-trained personnel to support, operate, and maintain them. To achieve the optimization of human performance, AFHRL is investing its resources in an R&D program to develop the technology to acquire and manage the highest caliber personnel force possible and to train this force to use and maintain sophisticated weapons systems. Technologies that appear to have order-of-magnitude implications for force effectiveness will be vigorously sought and resources applied to such efforts. Attention will also be given to affordability considerations of technology products in the development of our investment strategy. It is AFHRL policy to apply its available resources to projects and programs that have been requested by and coordinated with customers who are ultimately responsible for implementing technology development. It is also AFHRL policy to invest a significant fraction of its discretionary resources in the development of a research and technology base which is not contingent on the prior coordination of potential users. Within this group of investments, it is AFHRL policy to set aside some resources for projects that would not otherwise be supported. This approach is based on the observation that some of the most significant and far-reaching results of R&D have come from scientific efforts that were neither supported nor considered feasible within the scientific environment of the time. The potential for dramatic improvements in force effectiveness justifies the investment of resources in a limited number of such projects.

### DISTRIBUTION OF FUNDING

### FUNDING BY DIVISION ALL SOURCES

FY 83



**DOCUMENTATION  
AND  
PRESENTATIONS  
FY 83**

## AFHRL PUBLICATIONS

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AFHRL publishes Technical Reports (TRs), Technical Papers (TPs), and Special Reports (SRs). All three kinds of reporting documents are available at the Defense Technical Information Center for qualified users and at the National Technical Information Service for the general public. These documents are announced in the Technical Abstract Bulletin and in the Government Reports Announcements and Indexes published by the two organizations, respectively. They are also announced in the annual AFHRL bibliographies.

Technical reports are the documented results of Department of Defense sponsored research, development, test, and evaluation projects and communicate information generated as part of these projects. TRs are normally final reports. They document empirical findings that definitively resolve one or more R&D issues. TRs may include state-of-the-art reviews, dissertations, theses, or literature collections (including abstracts or annotated bibliographies).

Technical Papers are interim reports. Examples of materials appropriate for TPs include computer documentation, concept papers, professional presentations, briefings, lessons learned (such as empirical studies with negative or inconclusive findings), papers or widely used reference publications distributed on a recurring basis, and technical memoranda, bulletins, notes or working papers having permanent value. A final report may be published as a TP if relatively limited distribution is desired or if the empirical findings do not definitively resolve an R&D issue.

Special Reports are aimed at and tailored to specific Air Force users. They summarize R&D findings, conclusions, and recommendations for implementation in concise, non-technical language, with full documentation appended or cited.

## UNCLASSIFIED TECHNICAL REPORTS DISTRIBUTED IN FY83

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Carey, M.S., Densmore, J.E., Jr., Kerchner, R.M., Lee, A.T. & Hughes, R. *Effects of transport delay on simulator air-to-air engagements.* AFHRL-TR-83-8, AD-133 707.

Cicchinelli, L.F., Harmon, K.R. & Keller, R. *Relative cost and training effectiveness of the 6883 F-111 converter/flight control system simulators as compared to actual equipment.* AFHRL-TR-82-30, AD-A123 534.

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Finstuen, K. & Alley, W.E. *Occupational and personnel correlates of first-term enlisted tenure in the Air Force.* AFHRL-TR-82-36, AD-132 346

Finstuen, K., Weaver, C.N. & Edwards, J.O., Jr. *Occupational attitude inventory: Use in predictions of job satisfaction, reenlistment intent, and reenlistment behavior.* AFHRL-TR-82-21, AD-A121 192.

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Kerchner, R., Lee, A. & Hughes, R.G. *Air combat simulation visual display requirements: An application of engagement simulation modelling.* TR-82-39, AD-B072 581, (Limited to US Gov't.).

Martin, E.L. & Rinalducci, E. *Low-level flight simulation: Vertical cues.* AFHRL-TR-83-17, AD-A133 612.

Mathews, J.J. & Roach, B.W. *Reading abilities tests: Development and norms for Air Force use.* AFHRL-TR-82-26, AD-A125 913.

Nullmeyer, R.T., Killion, T.H. & Wood, M.E. *Companion trainer aircraft: Concept test.* AFHRL-TR-82-33, AD-A131 378.

Schipper, L.M. & Doherty, M. *Decision making and information processing under various uncertainty conditions.* AFHRL-TR-83-19, AD-A132 051.

Sorensen, P.H. & Pennell, R. *Technical training: Development of instructional treatment alternatives.* AFHRL-TR-82-32, AD-A123 323.

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## UNCLASSIFIED TECHNICAL PAPERS DISTRIBUTED IN FY83

Albert, W.G., Koplyay, J.B. & Whitehead, L.K. *REGRX: A computerized stepwise regression algorithm with residual analysis.* AFHRL-TP-82-40, AD-A123 987.

Askren, W.B. *Human factors products: A one-act play with epilogue.* AFHRL-TP-83-34, AD-A133 354.

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Borah, J. & Young, L.R. *Spatial orientation and motion cue environment study in the total in-flight simulator.* AFHRL-TP-82-28, AD-A129 391.

Boynton, T.A. *Table computation program: Users manual.* AFHRL-TP-82-41, AD-A128 268.

Buescher, R.M. (Ed.). *Utilization of people-related research, development, test, and evaluation: First annual report.* AFHRL-TP-83-4, AD-A130 330.

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Chambers, N.C., Brakefield, J.C., Yahiel, D.I. & Fulgham, D.D. *Stress assessment through voice analysis.* AFHRL-TP-83-47, AD-A132 577.

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DeMaio, J.C. *Velocity control decision-making ability: Relationship to flying capability and experience.* AFHRL-TP-83-32, AD-A136 546.

Duff, J.M. *Real visual image compensation for head motion parallax effects as a function of object distance.* AFHRL-TP-83-37, AD-A132 915.

Dube, W.M. *Electrical power line protection.* AFHRL-TP-82-38, AD-A126 229.

Farrell, R. & Barker, R. *Integrated cuing requirements (ICR) study: Feasibility analysis and demonstration study.* AFHRL-TP-82-25 (I), AD-A131 039.

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Finegold, L.S. & Asch, A.J. *Development of a low cost 3-dimensional computer graphics training system.* AFHRL-TP-82-45, AD-A124 557.

Hoffman, C.J. & McKinney, W.A. *ATMC, the multimedia teleconferencing system.* AFHRL-TP-83-26, AD-A129 850.

Hughes, R.G. & Graham, D.B. *Derivative fighter training considerations.* AFHRL-TP-82-42, AD-B071 284L. (Limited to US Gov't).

Hunter, D.R. *Comparison of live and simulated adaptive tests.* AFHRL-TP-82-35, AD-A124 167.

Jensen, J.M. & Barchus, W.L. *Minuteman maintenance training simulator: Maintenance training analysis and functional specification development.* AFHRL-TP-82-18, AD-B069 736L. (Limited to US Gov't).

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Lee, A.T. & Lidderdale, I.G. *Visual scene simulation requirements for C-5A/C-141B aerial refueling part task trainer.* AFHRL-TP-82-34, AD-A128 769.

Levine, M.V. *Identifying different item response curves.* AFHRL-TP-83-33, AD-A133 259.

Liberati, G.L. *Technology for acquiring supportable systems: Managerial overview of test and evaluation.* AFHRL-TP-83-10, AD-A128 742.

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Pierce, B.J. *Low altitude simulator training: A-10 aircraft.* AFHRL-TP-82-43, AD-A130 794.

Preidis, R.J. & Hollingsworth, M. *Weapon system costing: An investigation into cause-effect relationships.* AFHRL-TP-83-13, AD-A129 050.

Rogers, C.R. & O'Hara, S.A. *PRISM: A general purpose programming system.* AFHRL-TP-82-44, AD-A126 228.

Schvaneveldt, R.W., Anderson, M., Breen, T.J., Cooke, N.M., Goldsmith, T.E., Durso, F.T., Tucker, R.G. & DeMaio, J.C. *Conceptual structures in fighter pilots.* AFHRL-TP-83-2, AD-A129 885.

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Thomas, D.L. *Computer based maintenance aids system: Preliminary development and evaluation of a prototype.* AFHRL-TP-82-24, AD-A120 627.

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Warner, H.D. *Instructor station display for use in T-37 flight simulation training.* AFHRL-TP-83-38, AD-A134 845.

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Roberts, D.K. & Ward, J.H., Jr. *General purpose person-job match system for Air Force enlisted accessions.* AFHRL-SR-82-2, AD-A122 664.

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Longridge, T.M., Kruk, R. & Personnel of Dalhousie University. *Flying performance of the Advanced Simulator for Pilot Training and Laboratory tests of vision.* *Human Factors Journal*, February 1983.

Nunns, W.A. *Advanced instructional system.* *National Technical Information Service (NTIS) Tech Notes.* Center for the Utilization of Federal Technology, July 1983.

Pohlman, D.L. & Dallman, B. *Project TRIADS: The foundation for military computer-based training.* *Journal of Computer-Based Instruction*, Fall 1983.

Pohlman, D.L. & Edwards, B.J. *Desk top trainer: Transfer of training of an aircrew procedural task.* *Journal of Computer-Based Instruction*, Fall 1983.

Snow, R.E., Kyllonen, P.C. & Maryhalek, B. *The topography of ability and learning correlations.* In R. Sternberg (Ed.) *Advances in the Psychology of Human Intelligence*, Vol 2. Hillsdale, NJ: Lawrence Erlbaum Associates, 1983.

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Alley, W.E. & Matthews, M.D. *Relationships between predicted job satisfaction and attrition.* American Psychological Association Convention, Anaheim CA, August 1983.

Askren, W.B. *Maintenance and logistics factors in computer aided design.* National Aerospace and Electronics Conference, Dayton OH, May 1983.

Ballentine, R.D. & Weaver, C.N. *AFHRL Manpower & Personnel Division productivity research.* Office of Naval Research Productivity Symposium, Arlington VA, June 1983.

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Brooks, R.B. *Special function trainer.* Interservice/Industry Equipment Conference and Exhibition, Orlando, FL, November 1982.

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Burns, H. *TOPOI: A brainstorming program.* Pennsylvania Associates of Colleges & Universities, Hershey PA, September 1983.

Camp, R.L., Brown, R.H. & Ruck, H.W. *Implementation of an Air Force occupational research data bank.* 24th Annual Military Testing Association Conference, San Antonio TX, November 1982.

Christal, R., Payne, D., Weissmuller, J. & Anderson, N.S. *Learning abilities measurement program.* Psychonomic Society Meeting, Minneapolis MN, November 1982.

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DeMaio, J.C. *Flying ability and understanding of vehicle control.* Human Factors Society Meeting, Seattle WA, October 1982, and 4th Interservice/Industry Training Equipment Conference, Orlando FL, November 1982.

DeMaio, J.C., Rinalducci, E. & Brooks, R. *A psychophysical technique for evaluation of simulator visual displays.* 4th Interservice/Industry Training Equipment Conference, Orlando FL, November 1982.

DeMaio, J.C., Rinalducci, E.J., Patterson, M. & Brooks, R.B. *Psychophysical assessment of simulated visual displays.* Aviation Psychology Symposium, Columbus OH, April 1983.

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Eliaison, C.D. *A new look at the role of simulators in USAF training systems: An emerging position.* Royal Aeronautical Society Symposium, London England, April 1983.

Eulberg, J.R., Peters, L.H., O'Connor, E.J. & Watson, T.W. *Performance constraints: A selective review of relevant literature.* Annual Meeting of the Southwest Academy of Management, Houston TX, March 1983.

Fairbank, B. & Rilling, F. *A bivariate outlier detection and replacement scheme.* American Psychological Association Convention, Anaheim CA, August 1983.

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Frekany, G.A. & Cream, B.W. *Command and control decision making.* Human Factors Society Meeting, Seattle WA, October 1982.

Garcia, S.K. *Relative time spent rating scales: A historical perspective.* 24th Annual Military Testing Association Conference, San Antonio TX, November 1982.

Gardner, G.Y. & Gelman, B. *Simplified scene modeling using quadric surfaces and texturing.* 4th Interservice/Industry Training Equipment Conference, Orlando FL, November 1982.

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Kantor, J.E. *The Air Force pilot selection and classification research program.* Aviation Psychology Symposium, Columbus OH, April 1983.

Kavanagh, M.J., Hedge, J.W. & DeBiasi, G.L. *A closer look at the correlates of performance appraisal system acceptability.* Annual Meeting of the Eastern Academy of Management, Pittsburgh PA, May 1983.

Kellog, R.S. *Visual/perceptual aspects of an F-4G accident.* Human Factors Society Meeting, Seattle, WA, October 1982.

Killion, T. *Companion trainer aircraft: Aspects of dual qualification.* Human Factors Society Meeting, Seattle, WA, October, 1982.

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Nullmeyer, R. *Companion trainer aircraft: Concept definition and evaluation*. Human Factors Society Meeting, Seattle WA, October 1982.

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Seat, J.C. & Geltmacher, H. *Wide field-of-view visual display technology for flight simulators*. National Aerospace and Electronics Conference, Dayton OH, May 1983.

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1-5 November 1982

Annual Conference  
of the Military Testing  
Association,  
San Antonio TX

14-16 March 1983

Learning Research  
Workshop,  
Brooks AFB TX

5-7 April 1983

Interservice Training  
Review Organization  
(ITRO) Coordination  
Meeting,  
Lowry AFB CO

7-8 April 1983

Tri-Service Instructional  
Application Delivery  
System (TRIADS) Working  
Group,  
Lowry AFB, CO

20-23 September 1983

Productivity R&D Planning  
Workshop,  
Brooks AFB TX

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